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apc

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YOUR EXPERT GUIDE TO TODAY'S TECH

AUGUST 2020 #483

+ AMD B550 motherboards Labs tested

Ryzen 3 3100 & 3300X

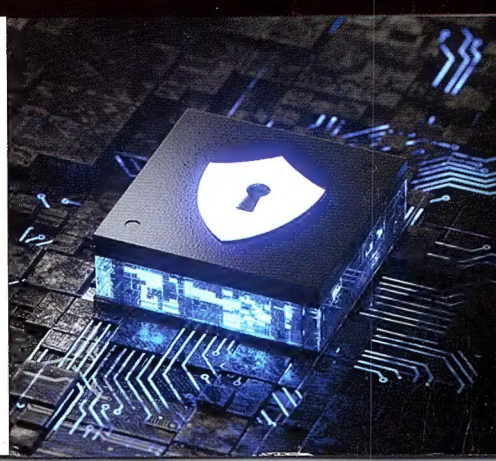
CHEAP CHIPS

Has AMD made budget *SEXY*?

HOW A $175 CPU STACKS UP AGAINST THE BIG BOYS

Surface Go 2

oes cheap mean cheerful
ith Microsoft's iPad killer?



Protect your data

- Encrypt folders & drives to keep your files safe
- The complete DIY guide to locking down your PC

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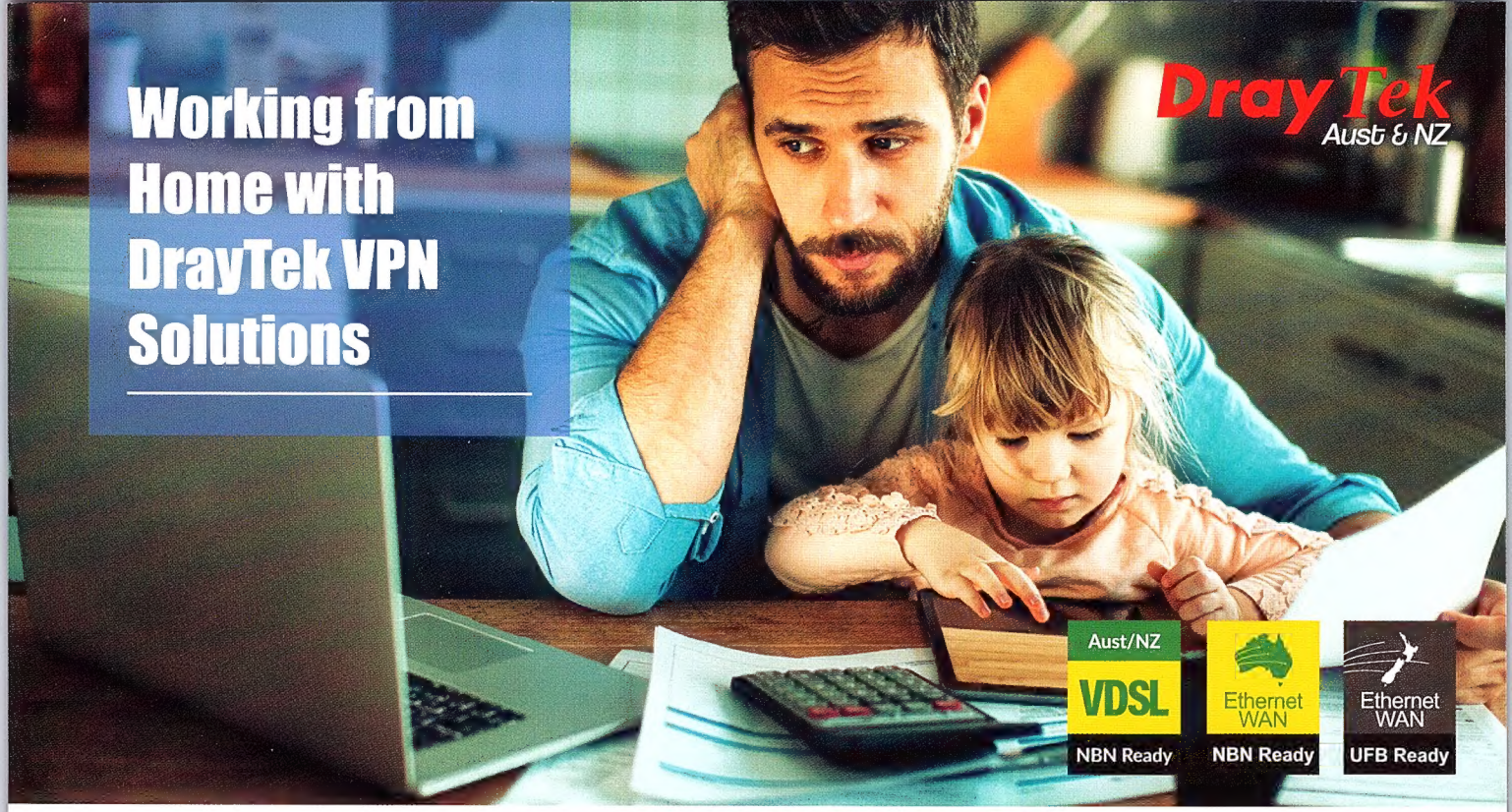

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EDITORIAL

WELCOME TO ANOTHER FINE MONTH OF COMPUTING

EDITORIAL

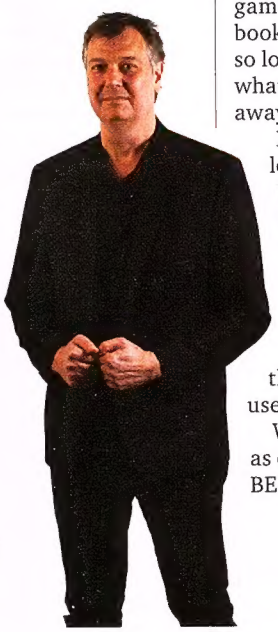
Good things

Come in all shapes and sizes.

There's so much going on in the world of the PC that it's almost ridiculous. For yet another month the CPU takes centre-stage – this time as AMD kicks down the door into the budget segment, while Intel has its long-standing relationship with Apple hitting the brakes. I'll spare you my usual CPU rant this time and let Chris tell the Ryzen 3100 and 3300X story in his reviews, which is a good new tale, along with his round-up of B550 motherboards – which is less rosy as we see motherboard prices continue on their relentless upward trajectory.

A couple of reviews that really stand out are the Intel NUC 9 Extreme and Microsoft Surface Go 2. Both teeny little things – one immensely powerful, the other far less so, but wins in other ways. It's always nice to see some activity in unconventional areas, I'm often told by industry insiders that the NUC scene is a roaring success, but that's largely covering the low-power units. This beast from Intel is packing basically the best of the best in components – and is priced accordingly. It's all very different and I can't help love it for just existing.

Meanwhile the Surface Go 2 offers a very interesting alternative to Chromebooks – at least in terms of the hardware you get, and its pricing. We were big fans of the first Surface Go because it offered a genuinely useable Windows device for around $500. At least one of our local *APC* team bought one to use as a commuting machine, and he's writing a book on it, too, which we're pretty excited about. Have a look at our gaming editor Shaun Prescott's book *The Town* to see why we're so looking forward to seeing what's next from Shaun, plugging away on that Go.



In *APC* news we've done some long overdue tweaking to our PC Builder Blueprint pages. Now, for each of our three hypothetical build categories (Budget, Mid-range and Turbo) we've created two builds – one Intel-based, the other AMD. Now, we hope, this section will be even more useful and relevant.

We all hope things are as well as can be with you, too.

BEN MANSILL

"This beast from Intel is packing basically the best of the best in components – and is priced accordingly It's all very different and I can't help love it for just existing."

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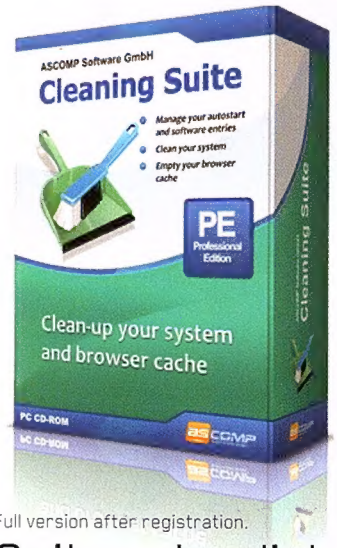

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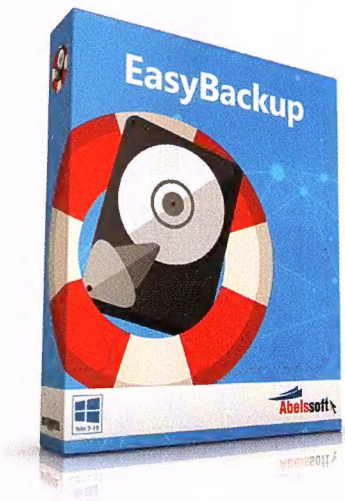

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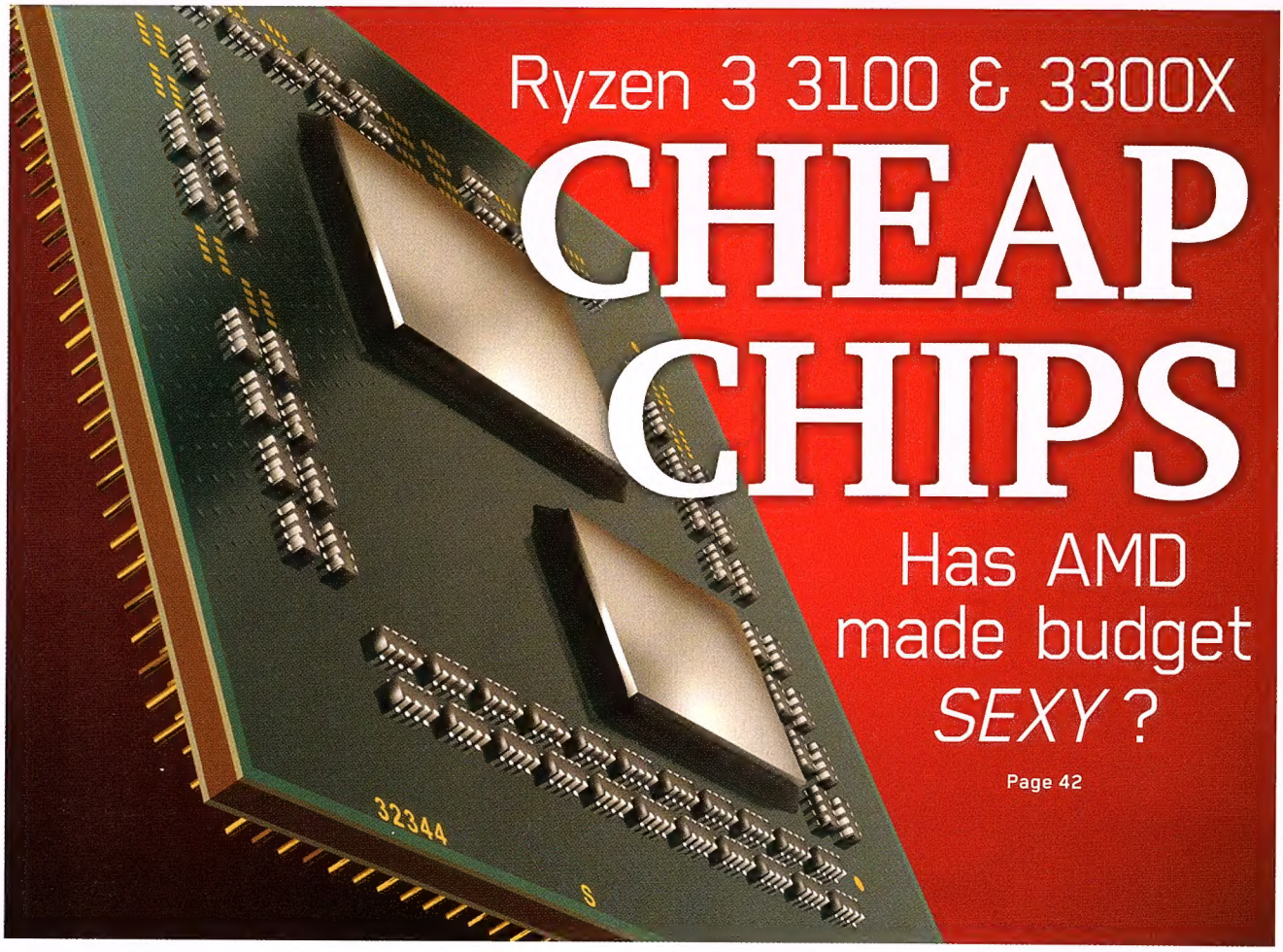

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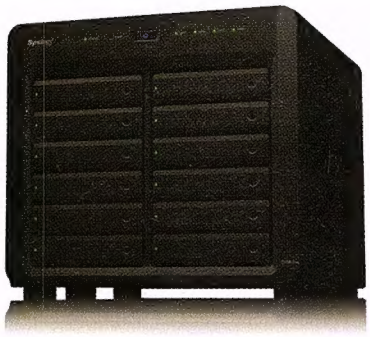

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Inside *APC*

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

"APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible."

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter offers better ease-of-readability, but tables are more compact, so we use these in most cases where thoroughness is preferred.

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TECHNOTES

ALL THE NEED-TO-KNOW TECH NEWS

Intel's Jim Keller resigns

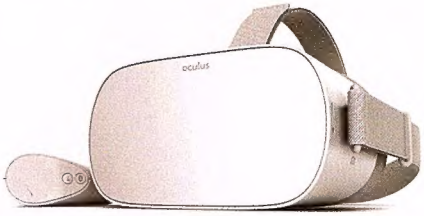
CHIP ARCHITECT AND LEAD SILICON ENGINEER DEPARTS.

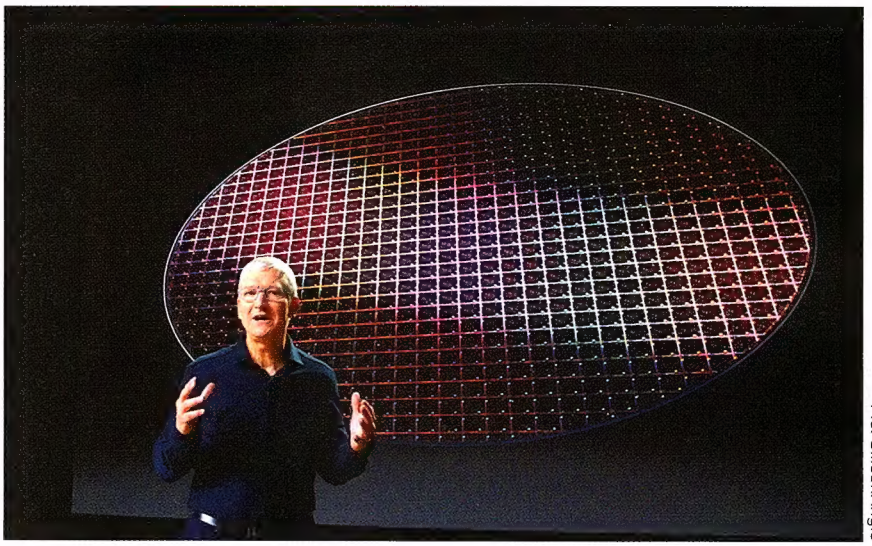
Intel has published a news release on its website stating that Jim Keller has resigned from the company, effective immediately, due to personal reasons. Jim Keller was hired by Intel two years ago to the role as Senior Vice President of Intel's Silicon Engineering Group, after a string of successes at Tesla, AMD, Apple, AMD (again), and PA Semiconductor. As far as we understand, Jim's goal inside Intel was to streamline a lot of the product development process on the silicon side, as well as providing strategic platforms though which future products can be developed and optimised to market. We also believe that Jim Keller has had a hand in looking at Intel's manufacturing processes, as well as a number of future products.

Oculus Go discontinued

FACEBOOK WILL NO LONGER OFFER ITS ENTRY-LEVEL VR HEADSET.

Facebook and Oculus announced that it will discontinue its Oculus Go VR headset to allow the company more room to work "on the next chapter in VR". The announcement came in a blog post on Oculus' website as well as an email to Oculus owners that thanked them for their interest in the headset and gave them a timetable for when the headset will set off for greener pastures. Oculus will continue to maintain the system software with bug fixes and security patches through 2022, according to the post. However, it also says that it won't be adding or updating apps and games after December 4, 2020. If you have one, now's the time to load it up with software.





Pic: SiliconAngle

APPLE CORES

Apple begins a two-year plan to dump Intel

Apple will phase out its use of Intel CPUs for ARM hardware in its Macs.

It is no longer a matter of *if* Apple will make a switch from using Intel hardware to ARM-based processors for its Mac lineup, but *when*, and the answer is soon... very soon. Apple made the announcement at this year's Worldwide Developers Conference (WWDC), saying it is embarking on a two-year transition to its own custom silicon, calling it a "truly historic day for the Mac."

To be clear, the transition is already well underway. Apple will ship the first Mac with "Apple silicon" inside by the end of the year, some 15 years after making the switch from IBM's PowerPC hardware to Intel's x86 processors. That will be the beginning of the transition period.

"With its powerful features and industry-leading performance, Apple silicon will make the Mac stronger and more capable than ever. I've never been more excited about the future of the Mac," Apple CEO Tim Cook said in a statement.

One of the reasons why Apple is moving away from Intel hardware is because it is seeking to establish a common architecture across its various product lines. The iPad, iPhone, and Apple Watch all run on custom designs based on ARM hardware, and soon so will the Mac. But commonality is not the only reason. According to Apple, CPU performance in the iPhone has improved by over 100x over the past decade. Likewise, Apple says the latest iPad Pro delivers 1,000x better GPU performance compared to the original iPad.

"The iPad Pro is faster than the vast majority of PC laptops, and this foreshadows how well our architecture will scale into the Mac," Johny Srouji, senior vice president of hardware technologies, stated during WWDC.

In essence, Apple is betting on itself to be able to create better silicon with more rapid improvements in performance than Intel. Incidentally, before the announcement, people apparently familiar with Apple's plans told *Bloomberg* the decision was made after seeing slower annual gains in chip performance from Intel. They also claimed Apple's internal tests showed "sizeable improvements" on ARM hardware versus Intel silicon, and "specifically in graphics" as well as AI-powered apps.

Intel will survive losing Apple as a customer, and may very well leapfrog back ahead of AMD in process technology within the next couple of years. But this isn't ideal. Apple is basically saying it can build more powerful Macs based on its own custom ARM hardware than it can with Intel's processors, just slightly less bluntly.

ARM, developed by Softbank subsidiary Arm Holdings, is a set of architectures that can be licensed out to other companies looking to develop their own chips, while maintaining a commonality across devices. Apple has a long history with the company, too, going as far back as the '80s.

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WD addresses SMR controversy

NEW RED PLUS HARD DRIVES COMING.

In response to heated criticism for not disclosing that some of its hard drives use slower SMR technology, WD penned a blog post outlining its plans to release a new line of WD Red Plus drives that use standard conventional magnetic recording (CMR) tech as an alternative to its slower SMR drives.

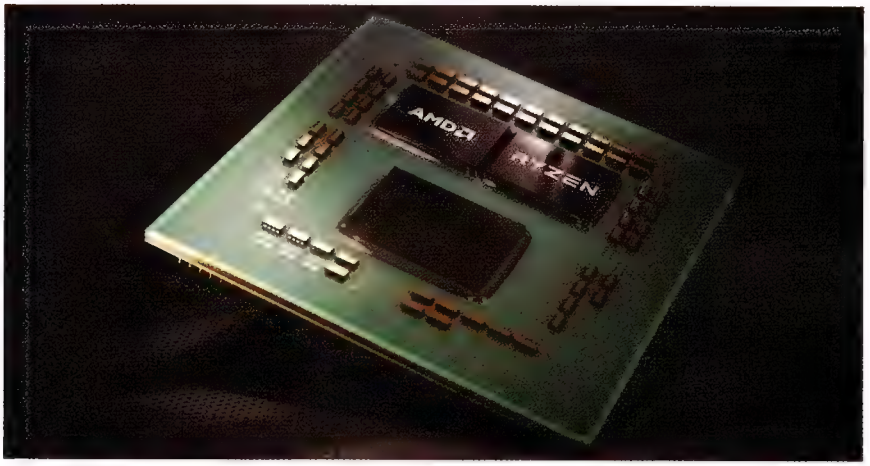
WD's change in course comes after widespread criticism from its customers about its surreptitious use of slower shingled magnetic recording (SMR) technology in some of its hard drives without disclosing that fact in marketing materials or specification sheets. Those claims of false advertising touched off a wave of class-action lawsuits, with one even calling for a ban to block WD from selling SMR drives for NAS usage.

Nvidia's latest driver lays the groundwork for next-gen games

FIRST PUBLIC DRIVER RELEASE TO SUPPORT MICROSOFT'S DIRECTX 12 ULTIMATE API.

DX12 Ultimate is a collection of technologies which Microsoft say deliver "an unprecedented alignment between PC and Xbox Series X." The API supports next generation graphics hardware features, including DirectX Raytracing (DXR), variable rate shading, mesh shaders and Sampler Feedback. At this very moment, Nvidia's GeForce RTX stack is the only one to support each and every one of those features. That will change when AMD's next-generation RDNA 2 graphics architecture arrives, which will power the Xbox Series X, PlayStation 5 and PC graphics cards.

Nvidia does not mention any specific game optimisations in the release notes for its latest 451.48 driver package, so there is not a whole lot to be gained in the here and now.



THE FOUR PERCENT

AMD launches new Ryzen 3000 XT chips

The Ryzen 9 3900XT, Ryzen 7 3800XT, and Ryzen 5 3600XT are now official.

AMD has fired back at Intel's Comet Lake processors with three new XT-series Ryzen 3000 processors that slot in as the new leading chips for the Ryzen 9, Ryzen 7, and Ryzen 5 families. The new processors bring AMD's Radeon XT branding to its desktop processor line, but they are physically similar to their respective predecessors. That means they come with the same 7nm process and Zen 2 architecture, number of cores and threads, L3 cache capacity, and TDP ratings, but serve up an extra 100 to 200 MHz over the standard boost frequency. Base frequencies remain unchanged. AMD says the incremental clock speed improvement provides up to four percent higher performance in single-threaded Cinebench benchmarks.

In a shift from AMD's standard practice, the Ryzen 9 3900XT and Ryzen 7 3800XT come without bundled coolers, while the Ryzen 5 3600XT comes with a bundled Wraith Spire cooler. The XT processors drop into any existing motherboard with a Ryzen 3000-ready BIOS, and offer drop-in compatibility with all 500-series motherboards.

	RRP	Cores / Threads	Base / Boost GHz	TDP	L3 Cache
Ryzen 9 3900XT	$809	12 / 24	3.8 / 4.7	105W	64MB
Ryzen 7 3800XT	$645	8 / 16	3.9 / 4.7	105W	32MB
Ryzen 5 3600XT	$399	6 / 12	3.8 / 4.5	95W	32MB

STACKING AND PACKING

Intel launches low power Lakefield hybrid CPUs

The smallest x86 processors are here, and with Foveros 3D stacking.

The new CPUs – a Core i5 and Core i3, have a 10nm single Sunny Cove core for heavier workloads and four low-power Tremont cores for background tasks that are less intensive. While ARM laptops, like those running Qualcomm's chips, have used a special version of Windows 10 for ARM that emulated 32-bit apps and doesn't support 64-bit, the Lakefield chips will natively support both.

It's going to be in the Samsung Galaxy Book S, a clamshell laptop that previously only came with a Qualcomm Snapdragon 8cx and is launching only in select markets, as well as Lenovo's upcoming ThinkPad X1 Fold. Intel says that the Foveros CPU package is 12 x 12 x 1 mm and gets there by stacking the two logic dies and two layers of DRAM. This also gets rid of the need for external memory.

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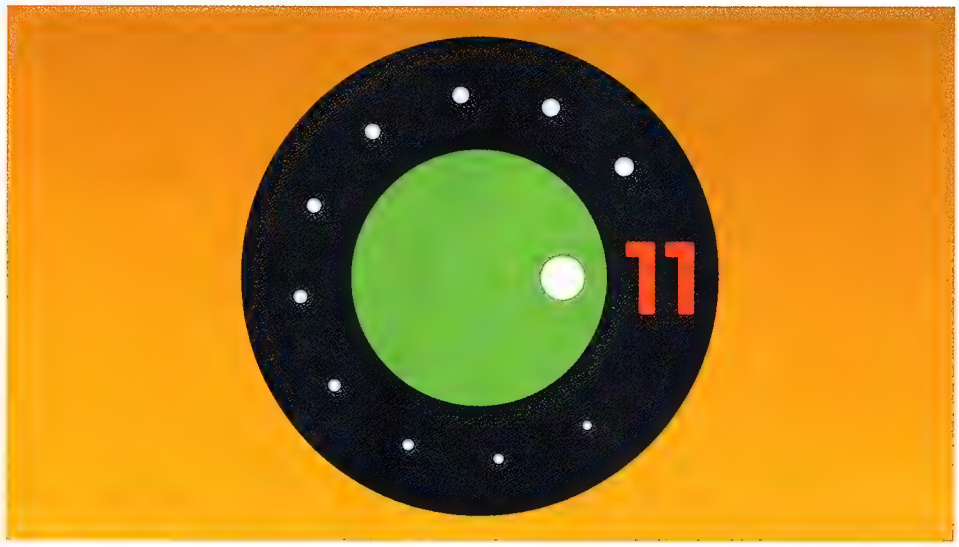


TECH BRIEF

Five surprising things we learned about Android 11

There's a little more going on than what Google announced with Android 11, and it's some pretty great stuff.

The 4GB size limit for video recording has been removed

For a long time, Android has had a file size limit of 4GB whenever you record a video. That wasn't so bad when you were shooting a low-bitrate 1080p video and saving it to an SD card that couldn't process files larger than 4GB anyway. But with 4K capable cameras, it meant that even a 15-minute video would be chopped into more than one file because it's too big.

With Android 11, that's all a thing of the past as the software classes and APIs that write media has been moved to use a 64-bit file size versus the original 32-bit. That means the theoretical maximum size is about 2,305,843,009 ((2^64)-1) Gigabytes.

Android 11 has a hidden Recycle Bin

If you've ever used Google Photos, you might know that deleting a photo or a video doesn't destroy it right away. Instead, there is a "Trash" folder that stores them for 30 days just in case you change your mind. It works the same way the Recycle Bin on a computer does, and now a similar feature is part of Android.

Apps that use the MediaStore API have three new features at their disposal with Android 11 – they can ask if you want to send a media file to the trash, mark it as being in the trash, and set an amount of time before it's deleted permanently. There's a system-wide limit of 30 days for storing "trashed" media.

Android 11 natively supports 84 new game controllers

Your Android phone can connect to a game controller that not only works as a gaming controller should but also as a weird sort of mouse if you'd rather not touch the screen. The problem is that there are so many good controllers out there that just don't work properly with Android, so the consensus has always been to just buy an Xbox or PlayStation controller. That changes with Android 11, as there are 84 new controllers with out of the box support.

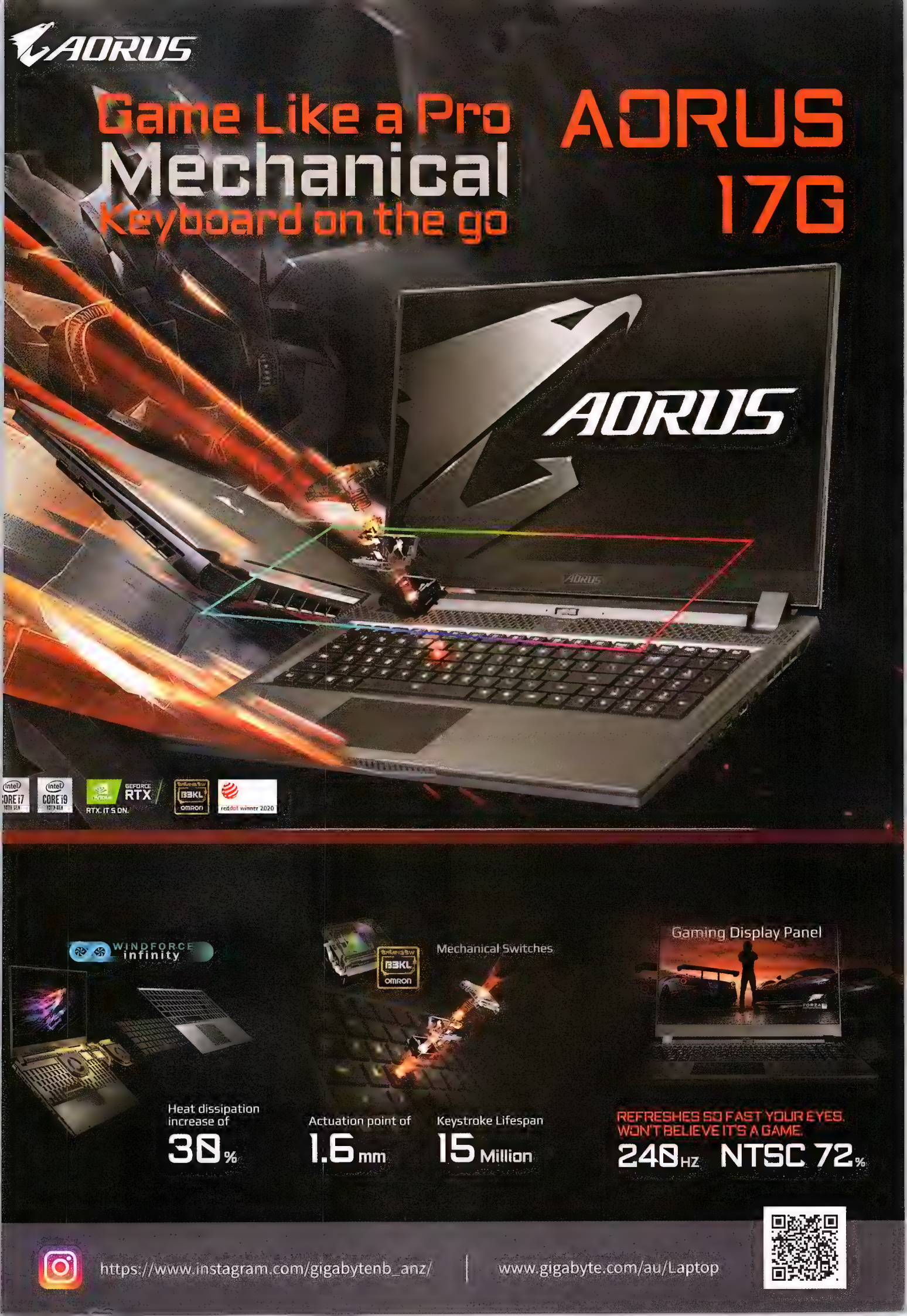
Voice Access can now understand what is displayed on your screen

Android Voice Access is an accessibility feature that allows a person to operate their phone by speech. Before Android 11, you had to tell Voice Access to do things like move down or move left to shift a virtual cursor to the different controls of an app, and that got very complicated very quickly.

With Android 11, Voice Access "just works" most of the time, and when you meet up with one of those times where it doesn't, you can move directly to a control by number without the app losing track of the rest of what it can understand.

Android 11 forces apps to support being backed-up

Apps targeting Android 11 are forced to support a local storage backup, but not a Google Cloud Storage backup. Android already offers a complete backup infrastructure. Hidden in your Google Drive account is free storage space that gives every app its own 25MB of space to store things like settings or game progress data. But there's another backup that can be done through ADB (Android Debug Bridge; a way for a computer and your phone to communicate) that locally creates a backup and saves it to your computer. The thing is, developers didn't have to support it. In Android, 11 backup files will actually work. Don't get too overjoyed though – apps must target Android 11, and we all know how that will play out. ■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Actuation point of
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Keystroke Lifespan
15 Million
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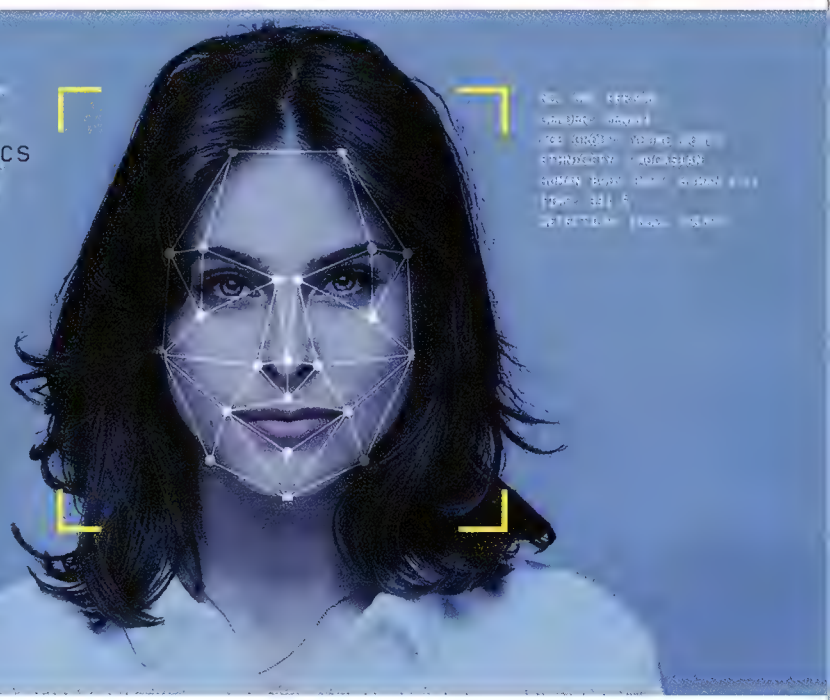
OPINION

APC'S EXPERTS COVER THE HOT TOPICS



"It's hardly "brave" or "controversial" for major corporations to pledge support for a popular movement, especially one as unambiguously moral: it's a great branding exercise and will probably prove profitable."

END USER

Big corporations support for social justice movements don't always check out

Amazon wants its cake and to eat it too, writes Shaun Prescott.

Following the May 25 murder of Minneapolis man George Floyd by former police officer Derek Chauvin, demonstrations have surged in the United States and throughout the world to protest racial injustice. In addition to the massive public demonstrations, most corporations have taken the opportunity to pledge support for the movement.

In the weeks (and months) following the May 25 flashpoint, every brand from Apple through to Starbucks has thrown its weight behind the Black Lives Matter movement in some manner or other. Indeed, it's basically a prerequisite: any major company that dares refrain is eventually castigated online; such was the case with Valve.

It's hardly "brave" or "controversial" for major corporations to pledge support for a popular movement, especially one as unambiguously moral: it's a great branding exercise and will probably prove profitable. But make no mistake: if it was unambiguously moral, but not a great branding exercise, the corporations would not pledge support for it. Many have offered material support in the form of massive payloads of cash; others have promised to address employment practises to favour inclusion.

Take Amazon for instance: CEO Jeff Bezos, whose net worth is 165 billion dollars, expressed his support for the movement on Instagram in May. The company has also donated a total of $10 million to organisations including the National Urban League, NAACP, UNCF and more. It's a safe, uncontroversial and inexpensive move that helps position Amazon as a "moral" company while it is arguably anything but.

A large part of the 2020 protests call for police reform, which is complicated for Amazon, which sells its facial recognition software, Rekognition, to police forces. A 2019 Massachusetts Institute of Technology study found that the software was perilously inaccurate when it came to black people. In late June, the *New York Times* reported on a Michigan man who had been arrested for a crime he did not commit due to faulty facial recognition.

While Amazon's Rekognition is hardly a household name, enough pressure mounted last month that the company announced a one year ban on the use of the software by police forces. "We've advocated that governments should put in place stronger regulations to govern the ethical use of facial recognition technology, and in recent days, Congress appears ready to take on this challenge," an Amazon spokesperson said. "We hope this one-year moratorium might give Congress enough time to implement appropriate rules, and we stand ready to help if requested."

SHAUN PRESCOTT
Author, PC gamer and passionate technology observer, Shaun covers trending tech topics for *APC*.

Under the circumstances, and given how unreliable the software has proven to be, it doesn't seem "moral" to keep selling software that can lead to false imprisonment. While Microsoft is hardly a paragon of virtue, it has opted to entirely ban the use of its own facial recognition software by law enforcement.

So after a year's moratorium on its use by police, Amazon is still keen to sell its facial recognition software to police – so long as someone else sorts out the legal details. In other words, the company's pledge of support to a movement that has at its very bedrock police reform, has not extracted itself from a surveillance technology used by police that is fundamentally flawed and ethically dubious, to say the least.

Corporations do not show support for mass social justice movements because they're inherently "good": they do it because it's good for the corporation. It may seem needlessly sceptical, even cynical, but let's check back in, in twelve months time, and see what has changed at the hands of big business. ■

Do I need to upgrade to Wi-Fi 6?

As new 802.11ax routers begin to appear on shelves you might be tempted to upgrade, but Wi-Fi 6 has been designed to achieve a few specific goals and they may not benefit everyone just yet.

Wi-Fi 6 is the next generation of wireless network communication protocols and since it's been in existence for a couple of years now it's probably something you've heard of at this point. Yet with the first routers really only becoming available at the start of 2020 there's a good chance you don't actually know what Wi-Fi 6 really is, why it was created, and whether it's worth upgrading to yet.

If you're anything like us you've accumulated a lot of smart home tech over the years, but even if you're not into installing smart speakers in every corner of your home, chances are you have a TV that can stream Netflix or a printer that's Wi-Fi only. Between the smart lights, Wi-Fi scales, smartwatches, and network-connected gaming consoles there's likely to be a lot more tech connected to our local networks these days and the trend doesn't look like it'll slow down anytime soon.

For those running full smart light arrays off a home router you've probably already noticed that it can impact the bandwidth you get on your smartphone, PC or TV, even if you have a top notch multi-antenna MU-MIMO router. Multi-User Multiple Input Multiple Output (MU-MIMO) was kind of a stop-gap solution for 802.11ac that prevented congestion when many devices connected to the same network by partitioning the total available bandwidth into multiple streams.

This 2x2, 3x3 or 4x4 segmentation meant that multiple connected devices could access the router simultaneously. While this reduces wait time, it means the router needs to divide the max theoretical speed amongst the total number of available streams. 802.11ac is theoretically capable of carrying a lightning fast load of 3.5Gbps, but once you divide that by 12 (4x4) you've only got about 36MB/s left of transfer speed per stream, which is about the rate of a USB 2.0 connection or just under a third of a HDD write speed.

Even the best Australian NBN speeds give you only 100Mbps (12.5MB/s), so there's no need to chuck out your current multi-antenna router just yet. However, it's pretty clear that you wouldn't want to constrain that 36MB/s max speed further by adding even more channels. Which brings us to the need for Wi-Fi 6, since 12 connected devices isn't really all that many any more (two smartphones, two laptops, one PC, one TV, one printer, two smart lights, two smart speakers and a smartwatch are enough to break it).

JOEL BURGESS
When not reviewing PCs for *APC* and writing our funny pages, Joel likes to ponder tech and how it's used.

Wi-Fi 6 ups this total speed throughput to 9.6Gbps, but as you may have guessed this speed boost is used to allow for more device connections rather than bolster maximum throughput speed per device. These MU-MIMO connections have also been opened up to allow both uplink and downlink communications, which facilitate access points handling even more devices than current MU-MIMO routers.

802.11ax (Wi-Fi 6) runs over the newly opened up 6GHz bandwidth and offers either seven or 14 channels to network over. This new 6GHz range offers the potential for reduced latency, faster transfer and a less congested network.

Other than this there's really just a few minor future-proofing improvements, which means Wi-Fi 6 isn't a major protocol transformation that offers massive benefits over existing 802.11ac solutions. Most people will be fine using their current network for at least a couple of years, or at least until you have a handful of Wi-Fi 6 capable devices. If you're planning on buying up a tonne of Wi-Fi 6 smart home devices when they eventually land (we haven't seen any yet), then it could be worth doing the groundwork for a future proof Wi-Fi 6 network, but it's still a bit early to need it. ■

Wi Fi 6™

CERTIFIED

TWO BITS

Are certain AMD motherboard manufacturers cheating?

Secret overclocking to boost performance.

Every so often I'm reminded of how ultra-competitive the motherboard market is. Sadly we may be witnessing something devious, as a result. Reports are that one or more AMD motherboard makers are altering the telemetry sent to the Ryzen CPU to make it think it's using less power than it actually is. This fools the CPU into thinking it has power headroom available to boost to a higher Turbo mode.

AMD power user 'The Stilt' posted an article at the HWinfo forum regarding the misreporting of certain AM4 motherboard-sourced telemetry. This data is used by Ryzen CPUs to set clocks based on information such as power budget, temperatures or voltages. If the information coming from the motherboard is outside of the normal specification, well, you can see how the CPU might start to act in ways it's not supposed to. The result is possible large jumps in stock CPU power consumption. The accuracy of this telemetry is termed as 'Power Reporting Deviation' on the latest beta build of HWinfo.

Using benchmarks to differentiate between motherboards can be uninformative. Assuming all other system components are equal, motherboard benchmarks often differ by only one or two percent. This is statistically within a margin of error, and conclusions can only be derived after repeat testing and identifying patterns over many different benchmarks. Given such small margins, motherboard manufacturers can and do employ various methods and tactics in an effort to gain that extra 1, 2 or 3 percent to put their board at the front of the pack. This could take the form of a 'performance boost' enabled by default, or tweaks to long duration power or current limits. Most of the time, these tricks can be observed and mitigated, so we reviewers can compare apples to apples. While many such methods aren't exactly above board, they generally aren't regarded as being deceptive, and that's what makes the power reporting deviation concerning. It's done without the user's knowledge.

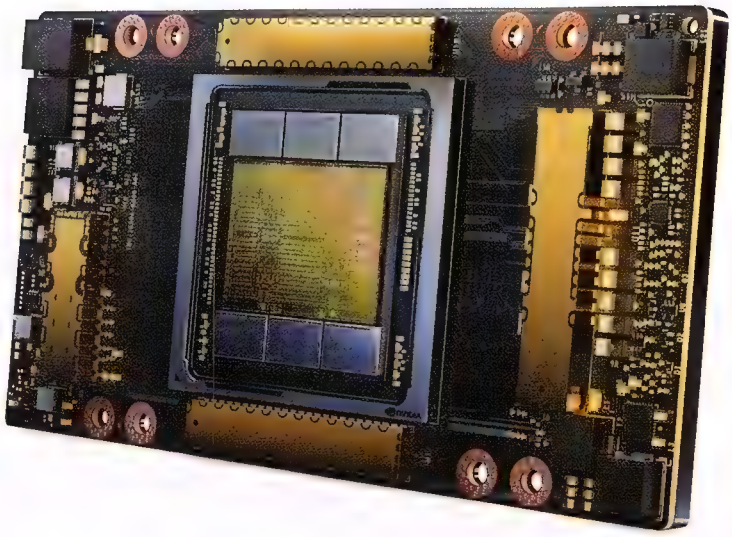
Some media jumped on this news with clickbait headlines. My concern isn't damage but temperatures and noise levels with inadequate stock coolers. The truth is that modern CPUs have many protections built in to prevent damage, so the chances of damaging your CPU are slim to non-existent in the short to medium term.

CHRIS SZEWCZYK
A life-long PC tech enthusiast, Chris has worked acoss the industry in many areas as a product and technology expert.

For now, I'm concluding that the whole story has been a bit overblown. AMD released a statement to *Tom's Hardware* stating in part: "We do not believe that altering external telemetry in the manner described by those public reports would have a material impact on the longevity or safety of a user's processor." That doesn't mean it's a nothing burger, though. I'm not prepared to call out specific manufacturers until we see peer reviewed data, but, if a manufacturer is essentially faking telemetry to boost performance – and it's a widespread phenomenon – then it warrants a good kick in the you-know-what for attempting a trick that until now was hidden from the end user.

Perhaps only AMD itself can step in and lay down the law so that its processors, when run at stock, are in fact run at stock.

This story may yet have some twists. ■



NEW IN APC

TECH TALK

The Nvidia A100 is the largest GPU ever created

Nvidia finally took the wraps off its Ampere architecture and the GA100 GPU. This is one monster of a chip and is the next iteration of Nvidia's datacenter and supercomputer ambitions.

Let's start with the raw specs. The full GA100 chip has 128 SMs (streaming multiprocessor), which are the main building block of Nvidia GPUs. The previous-generation Volta GV100 for comparison maxed out at 84 SMs (with 80 enabled), so right away we're looking at more than a 50 percent increase in potential performance, though the initial Nvidia A100 will "only" have 108 SMs enabled. Like Volta (and Pascal GP100), each SM has 64 FP32 CUDA cores, plus 32 FP64 CUDA cores. Where it gets interesting is in the other cores.

Like Volta – and unlike Turing – there are no RT cores for ray tracing. That obviously puts the kibosh on these becoming gaming chips, if the size and transistor count didn't already clue you in. More importantly, however, the Tensor cores are getting a major upgrade. The new A100 only has half as many Tensor cores per SM – four instead of eight – but those four cores provide twice the performance of the previous-generation Tensor cores.

These 3rd-generation Tensor cores have a few new tricks, specifically FP64 support (for science!), sparsity acceleration for matrices that aren't fully populated, and a new TF32 format that has the range of FP32 with the precision of FP16. It's basically like Google's bfloat16 format, using 19 bits with 10 for the exponent, eight for the mantiss, and one bit for the sign. What that means is a massive jump in deep learning and number-crunching calculations.

The Tesla V100 had peak throughput of 125 TFLOPS for FP16 deep-learning operations, but 7.8 TFLOPS for FP64 calculations. The Nvidia A100 has peak throughput of 312 TFLOPS for FP16, and up to 624 TFLOPS for FP16 operations with sparse matrices. It also has half that level of performance with TF32 operations and can do 19.5 TFLOPS of FP64 on the Tensor cores. That's 2.5 times faster for FP64, and Nvidia says in FP32 workloads (using TF32) the A100 is up to 20 times faster than the V100.

What about "normal" graphics workloads, using the CUDA cores? There are 6,912 FP32 CUDA cores on the A100, so 35 percent more potential performance, though boost clocks are slightly lower: 1410MHz vs. 1530MHz. That's still at least 24 percent more theoretical performance, and updates will likely make it much more.

For memory, the full GA100 chip has six 8GB HBM2 stacks running at 1,215MHz (up from 877.5MHz on V100), but the A100 accelerator only has five stacks enabled. That still means 40GB of memory on a 5120-bit bus and 1.6 TB/s of bandwidth, and potentially more on a future product. Power could be the limiting factor, as even the A100 with only 85 percent of the SMs enabled still has a rated TDP of 400W.

JARRED WALTON
There's nothing Jarred likes more than deep diving into how tech works.

The A100 supports a new feature called multi-instance GPU (MIG) that allows a single A100 chip to be partitioned into as many as seven "separate" GPUs, each delivering the equivalent instancing power of a single Tesla V100. Through MIG, Nvidia intends to serve the scale-out (more instances) as well as scale-up (more aggregate performance) markets.

Want even more performance? Stuff eight Nvidia A100 GPUs into a DGX A100 server, and you've got 156 TFLOPS of peak FP64 performance, up to 2.5 PFLOPS of TF32 performance, and 5 PFLOPS of FP16 performance. All for just US$199,000! Or a DGX A100 Superpod can house 140 DGX A100 systems with 700 PFLOPS of FP16 throughput.

Needless to say, supercomputers intend to make good use of the A100, with plans for Exascale (ExaFLOPS) supercomputers well under way. ■

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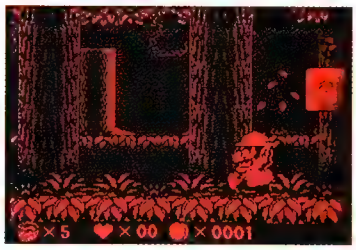
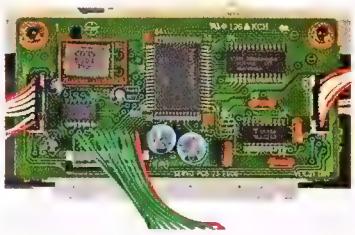
HOW IT'S DONE

TAKING THINGS APART AND HAVING A POKE AROUND



It took a while to snap this screenshot because Wario kept fidgeting.



An 8MHz crystal soldered to the board is used for timing the oscillation of the mirrors.

Nintendo Virtual Boy

Seeing red.

The Virtual Boy is a strange piece of gaming history. Nintendo called it a "32-bit, 3D experience" that "eliminates all external stimuli, totally immersing players into their own private universe." Even so, *Time* magazine listed it as one of the worst inventions of all time, and *PC World* called it one of "the ugliest products in tech history." So let's delve into the mystery behind the Virtual Boy.

Major tech specs

- 20 MHz, 32-bit RISC Processor
- 128KB dual-port VRAM
- 384 x 224 pixel resolution
- 2-bit monochrome display (black and three shades of red)
- 16-bit stereo sound

Key findings

- Taking the Virtual Boy apart is no walk in the park. Our 1/4" drive gamebit didn't fit into some of the recessed screw holes, so we had to get creative. After throwing sparks from our rotary cutoff wheel, we ended up with a gamebit socket that can be turned with a flathead screwdriver.
- The neoprene eye shield and its frame pop off the rear. After making short work of the screws securing the tripod base with our custom gamebit, it can be lifted off the lower case.
- After removing the rest of the screws, you can lift off the lower case. Ribbon cables attach the main board to components across the Virtual Boy. After disconnecting them, the board easily comes out. The main board takes inputs from the controller, loading game cartridge data, sending audio data to the speaker, and driving LED displays.
- A couple of Phillips screws secure the controller port and sound boards to the upper case. After removing the screws, both boards can be lifted out. The modular construction of the Virtual Boy indicates it was designed with repair in mind. A damaged controller port or audio system can be replaced individually rather than replacing the motherboard.
- A one-pixel-tall row of LEDs at the end of each display unit projects light through a lens in the middle of each unit. After passing through the lens, light is reflected off a mirror situated at 45 degrees that oscillates about its central axis. The mirror oscillates and the LED refreshes so fast that the human eye perceives a single image across the view plane.
- To oscillate the mirror, alternating electrical current at high frequency passes through a copper coil to the mirror. An iron core is attached to the display unit, forming a solenoid to produce the force. To tell the oscillator how fast the mirror is moving, an arm connected to the mirror passes through an optical sensor attached to the lower circuit board.
- Two T10 Torx screws secure the LED unit to the end of the display assembly. After the LED unit is removed, you can see the periscope-style reflection and slight magnification caused by the mirror and internal lens. Each four-color display unit features a 1 x 224 pixel resolution with 32 levels of intensity. Each "image" produced is a row of red dots. Used with the oscillating mirror, a full image is created.
- Repairability score: 6 out of 10. Modular design makes replacing ports easy. Phillips and Torx screws inside can be removed with the right drivers. Many components can be lifted out with little effort. However, opening the casing requires a specialised tool that took time to replicate. ■

The Virtual Boy was only available in North America for seven months until 1996, with only 770,000 units sold worldwide. Compare that with the Nintendo 64, which sold 32.93 million units over its lifespan.

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THE LIST

The best microphones for home use

08

Blue Yeti Nano

A more compact model of Blue's classic Yeti mic, this is a great starter microphone for anyone who is looking to break into streaming or podcasting.

07

Samson Meteorite

A shiny spherical mic with a magnetic base, the Meteorite is feature-light but not too expensive, and the recording quality is excellent.

06

Røde NT-USB

A pop shield and tripod make this a professional-looking microphone that apes studio-level hardware without breaking the bank.

05

Beyerdynamic FOX

A rare combination of USB-A connectivity and hi-res 96 KHz/24-bit audio support, the FOX is a multipurpose beauty, equally at home recording music and speech.

04

Razer Seiren Elite

The best free-standing mic from Razer. It's not cheap, but the Seiren Elite packs effective audio sensitivity and a high-pass filter into its single-capsule casing.

03

Audio-Technica AT2020USB+

A professional mic from a respectable brand, the AT2020USB+ is perfect for solo podcasting or live streaming. The tripod is a bit unstable, though.

02

Blue Yeti X

Blue's best microphone, it's equipped with the excellent Blue Vo!ce software for the best in flexibility and customisation. A noise-reduction toggle is invaluable.

01

HyperX Quadcast

Simply put, this is the best USB microphone available right now, boasting high build quality combined with fantastic audio pickup and intuitive physical controls. ■

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GADGETS

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$3,199 | optoma.com

Optoma UHD50X

A speedy gaming screen that's 30 times bigger than your average monitor.

While for many the fact that Optoma's UHD50X is a 4K projector capable of throwing a 302-inch picture across a wall in your house is impressive enough, but it also happens to be the world's first 240Hz gaming projector. Now, pro gamers shouldn't get their hopes up just yet since there's still a 15ms+ response time on its fastest setting, but for more casual console gaming this shouldn't be much of an issue. The UHD50X even supports HDR10 using its 3000 lumen peak brightness to display many more colours than conventional SDR TVs this is one of the closest things we've seen to a fully fledged cinema at home.

$249.95 | fitbit.com

Fitbit Charge 4

Fitbit's new tracker takes charge with onboard GPS.

The Charge 4 from Fitbit has traditionally only had connected GPS tracking, which meant you needed to keep your smartphone on you if you wanted it to map your workouts, but the Charge 4 now includes onboard GPS tracking, freeing you of the need to carry two devices. The Charge 4 also introduces a new Active Minutes activity tracking tracking interface that gives you a better picture of your daily health contributions than step tracking (which is a little rudimentary these days). There's also even new Spotify music playback controls to go alongside the long list of returning features like: 50m water resistance, on wrist payments, 7-day battery life, sleep insights and 24/7 Pure Pulse heart rate tracking.

$329 (500GB), $539 (1TB), $949 (2TB) | seagate.com/au

Seagate FireCuda Gaming SSD

An easy, instant, speedy storage upgrade.

Whether used for its marketed gaming purpose, or just as a very speedy portable external SSD, the FireCuda Gaming SSD is appealing. With a caveat... the claimed maximum speed of 2,000MB/s is only achievable if connected via the very new and currently rare USB 3.2 2x2 standard. In testing on a PC with the more common USB 3.2 Gen2 we saw read and write speeds just shy of 900MB/s – which is still well fast enough to make this interesting, and you could view the 2x2 support as good future-proofing. Inside is a standard Seagate M.2 510 NVMe SSD attached to a board. It looks slick and has a restrained RGB band around it, and appears to be very solidly built.

$149.95 | Razer.com

Razer Kishi

Turn your smartphone into a proper gaming rig.

The Nintendo Switch is proof of just how popular portable gaming systems are, but if you don't have the cash to nab one of these you don't have to miss out on comfortable on-the-go gaming thanks to Razer's Kishi. Suiting either Android or iOS this clever controller system attaches to the top and bottom of the most popular smartphones of today to give you a full array of buttons and joysticks to help you play games on your phone in full-screen. In the States the Kishi has been recommended for use with Nvidia's GeForce Now game streaming software so you can play your library of PC games on your Android. We're hoping this service isn't too far off being available here.

$1,399 | sonos.com

Sonos Arc

A sound-bending soundbar to make you the centre of attention.

The new Dolby Atmos enabled soundbar from Sonos is a standalone soundbar that is capable of reflecting sound off the walls in your media room to emulate true 5.1 multi speaker surround sound. This svette all in one speaker contains eight woofers that produce considerable bass for a system without a sub and the three additional tweeters bounce nice crisp high notes around the room. If you want a slick looking surround sound system without the clutter of accommodating multiple speakers then the Sonos Arc is one of the best soundbars you can get your hands on.

$349 | theragun.com

Theragun Mini

Punish yourself with pounding pain-relieving pleasure.

The Theragun massager machines have zoomed up in popularity recently – because they work. But, they are somewhat large, and very expensive ($900 for the Pro). We welcome the Mini because it can go where we go, when we resume going places. Packing this in your bag for a long haul flight means you can fix yourself at the other end quite nicely. The head pounds you with three selectable levels of brutality, and even on the weakest it is still punishing. And, that's why it works. I've paid for many hour-long massages that are no better than 10 minutes with the Teragun. It will pummel deep muscles with a steady thump, all in almost-silence. Very highly recommended.

Logitech has long been making 2.1 speaker systems designed for use with PCs.

HEAD TO HEAD

Headsets vs speakers vs headphones

Christian Guyton plugs in to find the best way to appreciate PC audio.

What's the best audio solution for PC users? Audiophile headphones are designed with music in mind, aiming to deliver the ultimate audio quality for professional and enthusiast users, while speakers – that's proper 2.1 speakers, not the tinny ones built into your monitor – are more about loud, room-filling sound. Then there's gaming headsets, brimming with cool features and designs to benefit PC gamers. All are good, but which option is best?

Value

This is a tricky one, since there's a broad price range for all three options. The more you spend, the better quality you get – mostly, anyway. So we're going to consider price against purpose, and price against performance. Gaming headsets take an early lead here, as they almost always include a built-in or detachable mic, and can be used for work, music, or gaming.

Audiophile headphones and speakers are typically more limited, and have a significantly higher ceiling for the amount of money you can spend. A somewhat high-end pair of Sennheiser headphones will run in excess of $1,500, while Razer's most expensive headset, the Nari Ultimate, is less than $300.

Speakers aren't too bad, with Razer's own high-end 2.1 sound solution (the Nommo Pro) costing around $900. The lower end of the price spectrum is kinder to audiophiles, with both headphones and headsets offering budget-friendly options, but if you work with music professionally, you may find that cheaper headphones just don't cut it.

With gaming, pitch-perfect audio clarity isn't quite as important compared to elements like mic quality and surround sound, so a less expensive headset will often suffice.

Winner: Headsets

Performance

Again, money talks here, but we think there's a clear winner – or at least, a clear loser. In terms of pure audio quality, gaming headsets just can't measure up against either audiophile headphones or 2.1 speakers. Yes, some audio will sound better on a headset – the punchy impact of a grenade detonating in a game might carry more weight – but broadly, gaming headsets aren't required to have the absolute best-quality drivers and materials.

To a certain extent, nor are speakers, but a 2.1 speaker setup has the advantage of size, with a separate subwoofer that allows for richer, more intense bass notes. In terms of raw volume, it's easy for 2.1 speakers to blast out audio, although many users will argue that surround sound is best experienced with headphones.

Razer's Nari exemplifies the gaming headset ideal: wireless, with all the trimmings.

Musical professionals demand a higher quality of sound; the average musician is more likely to appreciate subtle changes in audio than the average gamer. In order to appeal to audiophiles, headphones need to offer the best sound possible. Brands such as Grado, Denon, and Sennheiser know this: other features are always secondary to the sound, and optimising audio quality is the way to go.

Winner: Headphones

Versatility

We're starting to feel sorry for speakers now. They serve a purpose, but versatile they ain't. Headsets and headphones can be carried around either on your head or in a bag; many come with a carry case and compact, foldable design. Tape a 2.1 subwoofer to your head and you'll get some weird looks on the train.

So, with speakers out of the running, we decided to look at connection standards; audiophile headphones are rarely wireless, and often use the chunkier 6.3mm audio jack as opposed to the more common 3.5mm connector. This necessitates the use of an adapter for many devices, including computers, phones, and consoles. There's no significant boost to sound quality from either connector, but using an adapter is likely to impact performance by a small amount, which isn't ideal.

Gaming headsets are more likely to be wireless (either using Bluetooth or via a USB dongle), so nothing gets in the way of the audio experience. Wireless connections – perhaps with the exception of 2.4GHz connections – tend to cause a small drop in sound quality. This isn't a concern for most gamers but will be for musicians, hence the scarcity of wireless headphones from key manufacturers. Overall, headsets win.

Winner: Headsets

Comfort

If you're willing to shell out a significant amount of money, it's not hard to find a comfortable gaming headset. They're designed to be used for extended periods under potentially stressful conditions, often using breathable fabrics to keep your ears cool. Cheap out and you're going to be uncomfortable after an hour or two, though. Gaming headsets also tend to be heavier than audiophile headphones, due to the presence of a microphone and any other additions.

The stripped-back designs of many headphones mean that the manufacturer can focus on comfort, which is evident in many models: many Grado headphones use lightweight materials with open-backed ear cups designed for easy and comfortable listening. Gaming headsets almost always use closed-back cups, which leak less sound but cover the ear more completely, which can get warm and uncomfortable after a while.

Here's the thing, though. No matter how plush and impossibly soft the ear cushions are, it'll never compare to simply not wearing anything on your head and still being encompassed by rich, room-filling audio that can be enjoyed with friends: Nothing to wear, no cables running to your PC. This round is a shoe-in: Speakers win.

Winner: Speakers

Features

When it comes to features, headphones fail hard. Sacrificing add-ons (and often aesthetics) for pure, unadulterated audio quality means that many offer a stripped-back experience; ideal for the person who just wants to listen to music, but not so helpful if you want to play games or use Skype. In-line microphones are a rare sight, while they're virtually mandatory for gaming headsets. Integrated media controls are also significantly more common on headsets. Speakers lose points here too due to their purpose-built nature, but claw back second place by virtue of features such as home assistant integration and voice controls.

So, headsets win again. With features such as hi-res audio and 7.1 surround sound making the jump to gaming headsets, a high-quality gaming headset is now packed with features. Tools designed to work in conjunction with a mic, such as chat mixing and background noise cancellation, are also becoming common. Gaming brands are also more likely to explore other gimmicks, like the HyperX Cloud Flight S and its wireless Qi charging capabilities. We could go on, but while not all of them are actually that useful, headsets surge to victory for sheer breadth of features.

"When it comes to features, headphones fail hard. Sacrificing add-ons for pure, unadulterated audio quality means that many offer a stripped-back experience."

Master & Dynamic's high-end headphones are a boon for audiophiles.

Winner: Headsets

And the winner is...

It's gaming headsets! The most versatile of the three, they offer portability and a wealth of features. Speakers and headphones are pretty useless for online gaming without a mic, whereas a quality gaming headset can be used for listening to music or taking part in video calls.

If you need a multipurpose headset, don't dismiss gaming brands. Sure, RGB lighting won't add anything to your home audio experience, but a Discord-certified microphone and customizable media controls might. It's also not hard to find super-portable headsets that can be packed into a carry case when you're on the go, and can connect to your devices wirelessly or with a cable.

However, this is a case of shopping with purpose; if you're not a gamer but work with music, high-end headphones will serve you better than anything Razer or Steelseries can offer. If you live alone (or with music fans), consider 2.1 speakers – just don't be that person in Zoom who sounds like they're underwater because they don't have a noise-cancelling microphone! ■

REVIEWS

THE HOTTEST GEAR LABS TESTED

$2,399 (barebone kit) | www.intel.com.au

Intel NUC 9 Extreme

Maximum performance with minimum footprint.

In 2020 the stereotypical gaming PC is still a large black box, probably adorned with some form or RGB lighting, powerful AiO cooling and multiple fans. ITX has been with us for many years, and it has developed a loyal following, but for some reason, the words gaming, subtle and discreet rarely go together. That's what makes a device like Intel's NUC 9 Extreme appealing. It's a tiny high performance gaming machine that completely rejects any form of ostentatious theme that many gaming products too often embrace.

NUCs, or Next Unit of Computing machines are not new. Applications such as digital signage, office use or media streaming are naturally fitting applications. Gaming NUCs also exist, with the likes of the Zotac Magnus or MSI Trident offering a similar small form factor gaming experience. However, not many pack the specifications of the Intel NUC 9 Extreme into a chassis that's just 5L in volume. In fact, only genuinely high end gaming PCs are capable of outperforming it, no matter their size.

SPECS
(As tested) Intel Core i9-9980HK CPU; Asus Dual GeForce RTX 2070 Mini GPU; 2x8 GB DDR4-2666 RAM; Intel Optane 905p 380GB NVMe SSD & Kingston KC2000 1TB SSD; 500W PSU; 6x USB 3.2 Gen2, 2x Thunderbolt 3 Type-C; 1GB Ethernet & Wi-Fi.

Packing it all in

The Intel NUC 9 Extreme comes as a barebone kit. Open it up though and you'll find something quite new, with major system components being located on a PCIe daughter board called the Compute Element. This creates some intriguing upgrade possibilities should Intel continue to invest resources into the concept. Our machine came with the highest spec I9-9980HK option. It's an 8-core/16-thread laptop processor than can boost as high as 5.0GHz. With its 45W TDP, it's a great blend of performance and optimised power use.

It comes equipped with plenty of storage and connectivity options including four Type-A USB 3.2 Gen 2 ports, two Thunderbolt 3 USB Type-C ports, HDMI 2.0 (presumably tied to the on-board graphics when no discrete GPU is present) and two Intel Ethernet ports. Additionally it's got WiFi 6 on board. Nice! There are an additional two USB ports around the front along with an SD card reader. Overall it has an excellent set of I/O options.

The user needs to add their choice of 8-inch dual slot graphics card, SO-DIMM DDR4 memory, storage and operating system. There are three M.2 slots, two of which can accept Optane drives. Intel provided us with a fully kitted out sample of its NUC 9 Extreme which included an Asus RTX 2070 Mini 8GB and 2x8 GB of Kingston DDR4-2666. The supplied storage was top shelf, with a 380GB Optane 905P being one of the fastest drives on the market. It was joined by a 1TB Kingston KC2000 meaning there was plenty of room for all of our standard applications plus several space hogging AAA games. These are not cheap components though, and together they add a lot more expense onto the base 9980HK equipped machine, which is priced at $2,399.

Cinebench 20	Multi thread Score	3,573
Cinebench 20	Single thread Score	511
Peak CPU Power	Watts	90.1
Load temp	Celsius	92
3DMark TimeSpy Extreme	Score	6,319
3DMark TimeSpy Extreme CPU	Score	4,572
Ghost Recon: Wildlands	1080p, Ultra, Avg FPS	58.5
Metro: Exodus	1080p, Ultra, DX12, Avg FPS	62.6
Metro: Exodus	1080p, Ultra, DX12, Min FPS	32.9
3DMark TimeSpy	Score	8,899
3DMark TimeSpy CPU	Score	9,957

Playing with the big boys

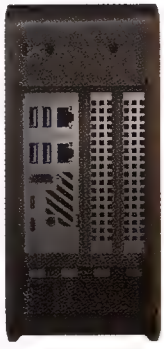
When it comes to performance, the NUC 9 Extreme actually performance beyond our expectations. Though of course gaming performance is defined by the capabilities of your graphics card. In *Metro: Exodus*, the 2070 equipped NUC held above 60 FPS at 1080P with the Ultra preset. Make no mistake, that's a very demanding test. *Tom Clancy's Ghost Recon Wildlands* is another brutal test at the ultra preset, with the NUC 9 Extreme resulting in a 59.5 FPS average. If it can run these at 60 FPS at 1080p, then we're confident in saying 1080p at maximum settings will be fine, with most less demanding games playable at 1440p and 4K too.

CPU based tasks performed admirably, with lightly threaded loads well suited to the Turbo characteristics of the i9-9990HK. In fact it's able to match a desktop i9-9900K in some instances thanks to that high boost clock. Heavy loads tend to throttle lower due to power restraints and unfortunately, a lack of cooling capability.

The main weakness of the NUC 9 Extreme is its cooling. Despite being equipped with a laptop class processor, a heavy all core load causes temperatures to climb quickly into the 90's which leads to the CPU lowering its clocks back to a laptop friendlier 3.3GHz, a 65W load and a more acceptable mid 70's temperature. For short duration all core load, the CPU will hold above 4.0GHz on all cores, and consume around 90W of power. Maximum system power draw under full CPU load was 154W at the wall.

"It comes equipped with plenty of storage and connectivity options including four Type-A USB 3.2 Gen 2 ports, two Thunderbolt 3 USB Type-C ports, HDMI 2.0 and two Intel Ethernet ports."

The compact size of the unit means there's no getting around the requirement for small fans, which tend to move up and down in speed. They become quite noticeable, but not truly loud. This combination of performance throttling and fan ramping leads us to conclude that Intel needs to improve the cooling solutions of future gaming NUC products.



Conclusion

The NUC 9 Extreme is a fantastic concept. We like the idea of its upgradeability, however, a properly configured Mini-ITX system can also be upgraded, and with more ease. There's also the cost. Intel weren't able to provide a total cost for our machine as equipped at the time of writing, but with a $2,399 base cost, plus the additional components including an RTX 2070 and an expensive and overkill 380GB Optane drive, we think we're looking at up to $4,000. That's a lot of money to build a very capable gaming PC with, albeit not one that's 5L in volume!

The idea of the upgradeable Compute Element opens up some interesting future upgrade possibilities, assuming Intel continues to invest in it. We really love the idea of a fast, compact and discrete gaming PC. Consoles gamers are used to small living room friendly machines, so it's only natural that there should be a market for similar PCs (that are much faster!) Of course there are other NUC type gaming PCs but not like the NUC 9 Extreme. While the concept is interesting, there are some hurdles. There's no escaping the noise or fan ramping concerns we have, though if you're using headphones it won't be a problem.

We think Intel is on to something here, but for now it seems like more of a development concept undergoing a market trial. If the Compute Element concept takes hold, and future NUCs can tweak the design a little (perhaps with a custom AIO solution?), then apart from the pricing gulf, there's nothing stopping Intel NUC's from taking a place in living rooms where the console remains dominant.

CHRIS SZEWCZYK

The NUC 9 Extreme is a fantastic concept but its sky high price and under par cooling leave us underwhelmed.

★★★½☆

$879 | microsoft.com

Surface Go 2

Is Microsoft's second attempt at a price conscious ultra-portable 2-in-1 a Go-er?

As our most used work applications continue to be integrated into web browsers, our files become increasingly stored in the cloud, and the advanced processing power required for gaming or technical work can now be easily outsourced via remote desktop subscription, the need for having a really powerful laptop is decreasing by the day. Well-priced compact devices like Microsoft's Surface Go 2 are perfectly positioned to cater to that seemingly inevitable future, and we honestly couldn't be happier about it.

SPECS
Windows 10 Home (in S mode) 64-bit; 10.5-inch PixelSense multi-touch screen @1920x1280 pixel resolution; Intel Pentium Gold Processor 4425Y; Intel UHD Graphics 615; 8GB RAM; 128GB PCIe SSD; 802.11ax Wi-Fi; 24.5x17.5x0.85cm; 544g.

The price and performance balance

The most affordable Surface Go 2 you can grab locally starts at $598 and comes with an Intel Pentium 4425Y processor, 4GB of RAM and 64GB of onboard storage, which is an offering that seriously competes with some of the best Chromebooks available. While this model only offers Wi-Fi networking and doesn't carry a heap of space, the Surface Go 2 does feature a MicroSD card expansion slot, which allows you to add cost effective storage to it as you see fit.

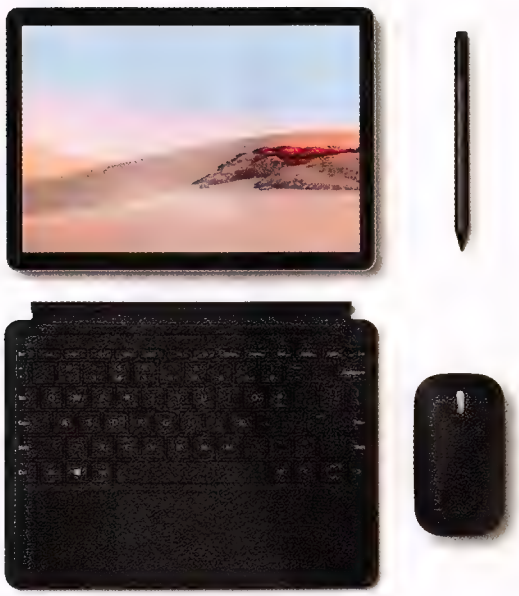
The next tier up doubles the RAM and storage allocations for a total of $879. This clearly moves the device out of the budget Chromebook-like space, but we'd recommend considering it if you intend to update to Windows 10 Home from the device's stock Windows 10 S OS, since it has that extra processing headroom for full Windows software and some additional space for all the non-Microsoft Store apps you'll have access to.

The last variation comes with an 8th generation Intel Core m3 processor, a CPU that was once used to power the Surface Pro lineup. Backing this up is the same 8/128GB RAM storage combo from the more powerful Wi-Fi offering, but the most important distinction here is that the Core m3 model comes with 4G LTE connectivity so you can access the internet from anywhere through a mobile data plan. This powerful configuration lands at a more expensive $1,199, which is on par with the entry level Surface Pro 7s, but when you have to fork out a few hundred dollars more for comparable constantly-connected professional 2-in-1s like the Galaxy Book S, it's actually a really competitive offering.

We tested the middle configuration here and although it has a less powerful processor it seemed to work exceptionally well for basic web browsing and light document processing. In Geekbench 4 performance was around 35 percent lower than we saw on a Samsung Galaxy Book S using a Snapdragon 8xc processor, which makes sense when you consider the 8xc is intended to be the mobile architecture equivalent of a 10th-gen Intel Core i5. We haven't compared it with the Surface Pro 7 Core i3-1005G1 CPU model, but we imagine they would stack up similarly and online reports suggest that it is only 10% behind the Apple iPad Pro 2020 in Geekbench 4 multi-core CPU benchmarks.

In addition to this considerable performance upgrade, which is reported by Microsoft to be up to 64% more powerful than the previous iteration, the Surface Go 2 has a bigger 10.5-inch 1920 x

Indicates best result	Microsoft Surface Go 2	HP Envy x2
PCMark 8 - Home (score)	1,963	929
Geekbench 4 - Multi-Core (score)	4,228	3,129
PCMark 10 - Express (score)	2,292	1,059
3DMark Fire Strike (score)	835	485
Battery life - 1080p video playback (h:min)	07:58	10:56
Peak CPU temperature (°C)	54	NA
CrystalDiskMark Read (MB/s)	1784.1	778.5
CrystalDiskMark Write (MB/s)	846.55	262.7



"It's hard to imagine a use case for this device without the need for the Surface Go Signature Type Cover, so you'll have to plan for that extra $199.95 outlay."

1280 (3:2) PixelSense display that is really vibrant for a budget screen. With a peak brightness of 280nits it's not really in the league of the 600nit HDR Apple iPad Pro, but it's more than enough to give media and documents the colour and clarity they deserve, even in direct sunlight.

Putting it to work, and play

For those wanting to do a bit of light gaming, all models come with an Intel UHD Graphics 615 GPU, which is enough to play 2D indie games at full resolution or even titles like *Rocket League* at around 42fps if you dial down the graphics to High Performance 1152x864p settings. This aspect ratio is actually 4:3 rather than the Surface's signature 3:2, so it didn't look perfect on the Surface Go 2, but you are somewhat limited by the number of titles that will have a wide selection of resolutions in the 3:2 aspect ratio.

Microsoft spent some time bolstering the web conference capabilities by adding two new far field studio microphones to improve voice recognition and vocal clarity in web calls. This marries with the capable 8MP rear and 5MP front-facing cameras to offer solid 1080p online meeting capabilities (which seems to be critical these days). Microsoft has included a new free Photo app that allows you to take pictures, scan documents and capture whiteboard notes quickly and easily.

While the screen is half an inch bigger, the overall size of the device is identical to its predecessor at 24.5cm by 17.5cm high and just 8.5mm thick, which means the screen to bezel ratio is better on the new device. The tablet itself is also only 544g (553g for LTE) and even if you add the 245g of the Surface Go type cover, you've got a 2-in-1 device weighing in at under 800g, which is just about impossible to beat.

It's hard to imagine a use case for this device without the need for the Surface Go Signature Type Cover, so you'll have to plan for that extra $199.95 outlay. This does push the device into the top end of the budget Chromebook-equivalent category, but this compact keyboard benefits from all the learnings of the longstanding Surface Pro cover range. The Surface Go 2 Signature Type Cover is undoubtedly compact, but the typing experience is good enough that you'll quickly adapt and the trackpad is silky and a nice size for scrolling, selection and gesture control.

All systems go

The Surface Go 2 ships in Windows 10 S, but Microsoft has made it easier than ever to swap over to full Windows 10 Home through a simple update that doesn't even need a restart. While you may have seen better battery life from Windows 10 S, once updated to Windows 10 Home the 26.8Wh battery lasts five hours and five minutes in PCMark 8 Home battery and around 8 hours in 1080p media playback, so there's no real battery benefit from keeping it in Windows 10 S anymore.

The USB-C, 3.5mm headphone jack and Surface Port offer a well rounded selection of interface options that make it easy to connect wired headphones on flights or plug modern docks and devices directly into the unit. You've also got the microSD card slot for affordable storage expansion and the latest Wi-Fi 6 networking capabilities for a fully untethered experience.

JOEL BURGESS

A powerful, affordable and lightweight computing device that's perfect for students and professionals who only need light document processing and web browsing.

★★★★½

"Dropping in six Seagate Ironwolf Pro drives is the work of minutes, and the Synology software walks you through your desired setup."

apc RECOMMENDS

$3,600 | www.synology.com

Synology DS3617xs

A small business server that offers flexibility and performance in a compact package.

Aimed at small to medium businesses that need a lot of performance, the $3,600 Synology DS3617xs is not your average NAS. Think Rackstation server in a NAS form factor, optimised for virtualisation and performance intensive tasks, as well as backing up loads of data. While the underlying hardware is getting a little long in the tooth, the Synology software is continually updated with new features. The flexibility of the NAS server and associated ecosystem and add ons also means it can perform well across a broad range of businesses.

Accessible via lockable hot swap bays, the DS3617xs has 12 drive bays that can handle up to 192TB of 3.5-inch or 2.5-inch drives. Buried inside the NAS is an aging but powerful Intel Xeon D-1527 CPU, with four cores (and eight threads) that can boost from 2.2GHz up to 2.7GHz. It ships with 16GB of DDR4 RAM, which is user upgradeable to a total of 48GB. Round the back it has four Gigabit LAN ports that can be used for link aggregation or failover. You also get dual USB 3.0, plus two expansion ports. But most importantly, the DS3617xs has Gen3 PCIe x8 expansion slot, for add in cards.

SPECS
CPU: Intel Xeon D-1527; RAM: 16GB (upgradeable to 48GB); Drive Bays: 12x 3.5in/2.5in (max 192TB); LAN ports: 4 x RJ-45 1GbE; PCIe Expansion: 1x Gen3 8x Slot; USB 3.0 ports: 2x.

The name of the game is flexible upgradeability. The RAM is easily self-installed via a removable side panel, and you can connect external HDDs via USD 3.0. The expansion ports can support Synology units such as the DX1215, for a total of an extra 24 drives. The PCIe slot means you can drop in a variety of 10Gbps network cards, or a M2D18 M.2 SSD adaptor. Annoyingly with the latter, the DS3617xs itself only supports SATA SSDs, while the adapter can handle NVME.

Software is where the NAS server truly stands out, and the name of the game here is visualisations. Don't get us wrong, the DS3617xs has hardware AES 256-bit encryption, and can handle the usual automated backups, data storage, office collaboration, private cloud storage, mail servers and more, but that quad core Xeon CPU wants to be put to work. You can run virtual machines using Windows and Linux, quickly creating (or re-creating in the event of a problem) resources for users and clients. The Virtual Machine Manager is quite feature rich, and provides an easy interface to manage software running on your NAS, and supports industry standards such as VMware vSphere, Microsoft Hyper-V and Citrix Xen server.

So how does it perform? Dropping in six Seagate Ironwolf Pro drives is the work of minutes, and the Synology software walks you through your desired setup. Exact performance figures are highly dependent on your RAID setup, network and add in cards. With six Ironwolf Pro NAS drives in RAID 0, we managed up to 2,431Mbps reading and 4,523Mbps writing 5GB files over a 10GbE ethernet connection. The same goes for virtualisation, and Synology recommends up to eight if you run the full 48GB of RAM. The DS3617xs is fairly quiet, but somewhat power hungry and peaked at 103W under load.

It's not perfect, but for great software and server performance in a desktop NAS box, the DS3617xs is worth considering for your business.

LINDSAY HANDMER

Despite a few minor downsides, the DS3617xs holds up quite well and offers flexible performance and great software features.

★★★★☆

$1,000 | www.synology.com/en-au

Synology DiskStation DS920+ NAS

Synology's popular four-bay NAS gets a long-awaited update. But how significant is it?

Synology's four-bay DS920+ NAS is the follow-up to 2017's incredibly popular DS918+. At a glance, not much has changed and the fact it runs the Synology's constantly updated software means there's virtually no difference in operation, either. Nonetheless, the improved memory and processor speeds make this a welcome update to Synology's vast army of enthusiasts and if you've been thinking of buying a NAS, this may be what you've been waiting for.

The NAS has four, lockable 3.5-inch drive bays which offer easy, hot-swappable access to what's inside. There are also two, M.2 2080 NVMe drives for fast caching and increased storage. At the rear is an eSATA port which can be used to connect additional drive bays plus a USB 3 port that can connect storage, a printer or a mobile internet dongle. There are two Gigabit Ethernet ports which will suit most domestic requirements however, SMBs who rely upon these NAS boxes to service multiple users on a LAN may find this limiting. They also mean that the NVMe drives can hit a bottleneck when it comes to post-browser operations. However, they'll still improve the performance of onboard Virtual Machines and video processing (for surveillance cameras or PLEX videos). It's relatively silent at 20dBA with most noise coming from your choice of hard drives.

A major attraction of Synology is the plethora of well-featured software which comes licenced with the DiskStation Manager operating system. A vast library of native (and third-party) apps enable each NAS to act as a powerful, hybrid cloud which is a cost-less alternative to the expensive, multi-seat, subscriptions from mainstream players. They include server software for business-grade email, file sharing, back-up, music, media, messaging, surveillance cameras and much more. All bespoke apps have been significantly tweaked over the years to run with excellent memory management.

The NAS is also useful if you need to maintain full control over your organisation's cloud-based data as everything can be backed up – even when using third-party cloud services. That's particularly useful if you're worried about an ex-employee deleting important emails from G-Suite that you can't otherwise get back.

SPECS
2GHz Intel Celeron J4125 4-core CPU; 4GB DDR4 RAM (expandable to 8GB); 4 x lockable 3.5-inch drive bays; 2 x NVMe M.2 2080 drives, eSATA; USB 3.0; 2 x 1Gbe Ethernet ports; Synology DiskStation Manager operating system.

If all of this makes owning a NAS sound irredeemably complicated, be assured that the vast Synology community has libraries of how-to videos and instructions on setting-up every type of application.

If you own a DS918+ you'd have to be a major enthusiast to want to upgrade to the DS920+ and new buyers should tarry too: the older model costs $750 compared to the $1,000 DS920+. If you rely on your NAS for business then the 2GHz, quad-core Celeron processor plus 4-8GB DDR4 RAM will make a difference to multi-user performance over the older 1.5GHz 4GB of DDR3, but it's doubtful domestic users (using it for PLEX and back-ups) will need the incremental performance boost. Whichever, you choose, a four bay Synology NAS is a great domestic entry point that can easily expand into a fully-featured SMB work-horse and, as such, should be at the top of the list for many buyers.

NICK ROSS

Simultaneously a great expandable entry point for NAS newbies and a powerful, feature-laden office server for SMBs.

★★★★★

$1,299 | www.viewsonic.com

Viewsonic Elite XG270Q

Viewsonic meets LG in this pristine gaming monitor

A quick glance over the specs list suggests there's not actually a lot of new tech here; we've had 165Hz, QHD, IPS gaming monitors with G-Sync for some time now. But there's more to the Elite XG270QG than that. It's a combination of design aesthetics and some new tweaks to the technology that makes it truly impressive.

It all comes down to the panel at its heart. Viewsonic's taking advantage of LG's pioneering IPS Nano Color tech. It's actually a relatively new panel type, first debuting in about 2018, and we've seen very few manufacturers actually take it up in the gaming monitor space. The reason for this is that it adds a fair amount of cost to a screen, but improves colour accuracy quite remarkably. With most IPS panels, the biggest issue when it comes to colour reproduction in the RGB spectrum is the white backlight that sits behind the pixels. Because this light is entirely white, it emits a considerable amount of additional light wavelengths through the pixel itself (i.e. noise), which in turn can warp certain colours from showing accurately.

To get around this, LG developed Nano IPS. It's a thin layer of light-absorbing material that's coated directly onto the backlight itself. In fact each particle is just below the 2nm mark, which is what gives it its name. These particles absorb those particular wavelengths of light that can otherwise distort a colour, which in turn increases both the spectrum of colours you can represent, and how accurately those colours can be displayed. LG states that, with its Nano IPS panels it can achieve a colour accuracy of 98% of the DCI-P3 spectrum (or 135% of the sRGB space). That's the spectrum HDR itself relies on.

SPECS
Resolution 2560x1440; Pixel Density 109 ppi; Panel Type 27-inch Nano IPS; Maximum Refresh 165Hz; Contrast Ratio 1000:1; Response 1ms G2G; Display Inputs 1x DisplayPort 1.4, 1x HDMI 2.0.

The monitor itself looks fantastic – the company is clearly straddling that fine line between gaming and professional. There's no ostentatious displays of gaming styling, nor is it so slick you'd mislabel it as an Apple product.

It's also stupidly well-equipped. It features a 1ms G2G response time, a 165Hz refresh rate, and G-Sync as standard. Combine that with the impeccable colour response, and what you're looking at is an exceptionally adept gaming monitor. In fact we'd go so far as to say this is genuinely the first time we've seen a mid-range to high-end gaming monitor that didn't suck for people who enjoyed or worked with colour.

That actually makes a lot of sense – in the past we'd easily let go the foibles of a gaming monitor because they provided us with the super-snappy response times or the ridiculous refresh rates, in exchange for colour and viewing angles. Vice versa, 60Hz and a 9ms G2G was fine when looking at a bezelless, classy artworker screen. In the case of the XG270QG, it happily straddles both of those, with little concern on either front. On top of that, ghosting is minimal, even under the most intense firefights, G-Sync works well, and 165fps is about as fast as this journalist's eye can tell the difference. Yes, it does come with one heck of a price tag (if you can manage to find it in stock), but for what you're getting, there really aren't any alternatives out there. If you're after the best 27-inch 1440p gaming monitor today that money can buy, the Viewsonic Elite XG270QG is the king.

ZAK STOREY

Impeccable colour accuracy; massive feature set; clean design; strong ergonomics.

★★★★½

$2,099 | www.asus.com/au

Asus TUF Gaming A15

Asus has updated its long-lasting entry-level TUF gaming rig, but has the novelty of this newish range already worn off, or is it here to stay?

We've been fond of Asus's TUF ('The Ultimate Force'... oh please, Asus) branded gaming laptops ever since they emerged in 2018 with a reengineered fan design that repelled small particles to prevent dust build up and help prolong the life of the unit. This strive for longevity continues today in the TUF Gaming A15 which sees the return of an upgraded version of this self-cleaning cooling system and novel features like an optional 90Wh battery to keep the device running longer in day-to-day use.

The most striking feature of the A15 is a new chassis design that marries a number of interesting elements into one cohesive design. The top shell can either be a flat silver polished piece of aluminium or an angular brushed metal and carbon-fibre-looking case that takes inspiration from HP's Omen range. The main thing however, is that both look appropriately sci-fi without being unsuitable to take to the office. Returning again are shock, thermal and humidity resistances and after-market customisations that can help keep your device current for longer. In addition to the upgradable RAM, you also get an additional PCIe and a SATA 3 slot to add more storage.

SPECS
Windows 10 Home; 15.6-inch 144Hz IPS display @1920 x 1080 pixel resolution; Nvidia RTX 2060 GPU; 16GB RAM; 512GB PCIe SSD; Realtek ac WiFi; Ethernet; 35.9x25.6x2.2cm; 2.3kg.

Since its primary purpose is to be a gaming laptop, it's got plenty of powerful components and a few neat perks that help it to go fast as well as far. The first is a 15.6-inch FullHD screen that comes at either 60Hz or 144Hz refresh rates and covers either 45% or 72% of the NTSC colour gamut. When you consider that 72% NTSC is equivalent to a standard sRGB monitor, your games will not look very vibrant if you opt for the cheaper display here. This is compounded by a peak brightness of around 280nits, which is a little too dull and won't make games look great if there's much sunlight where you're using it.

The A15 has a choice of three AMD processor options of a Ryzen 5, 7 or 9 for the CPU. The unit we tested had a Ryzen 7 4800H and 16GB of RAM, but you can expand the latter up to 32GB if needed. Because this is designed to be a value device the choice of GPU includes the Nvidia GTX 1650, 1650Ti and the RTX 2060. We took the most powerful option here for a spin with a 512GB PCIe SSD, a configuration that was available online for $2,099.

The CPU in the A15 we tested did surprisingly well, getting 5,315 in PCMark 10's Overall benchmark and 12.9fps in HWBOT x265's 4K media encoding benchmark, which was within a few percent of the ROG Zephyrus G14 running a Ryzen 9 4900HS and other comparable specs. Onboard storage speeds were first gen PCIe SSD level at around 1,750MB/s either way and the graphical performance was where you would expect it to be, netting around 45fps on *Ghost Recon: Wildlands*, 62 on *Total War: Warhammer 2* and 66 on *Middle Earth: Shadow of War* using Ultra 1080p settings.
The unit we tested used a 45Wh battery and managed three hours and 15 minutes in PCMark 8 Home Battery, so you should be able to get a full working day if you decide to get the model with the 90Wh battery. JOEL BURGESS

Indicates best result	Asus Tuf Gaming A15	Asus ROG Zephyrus G14	Aorus 17
PCMark 8 - Home accelerated	4,793	4,606	4,665
PCMark 8 - Home Battery	03:15	04:13	02:23
HWBot x265 - 1080p	55.733	54.472	46.746
Cinebench R20 - multi-threaded CPU	4,366	4,224	3091
3DMark Time Spy (score)	6,317	5,799	9,045
Total War: Warhammer II - Ultra 1080p (fps Av.)	62.3	56	89.3
CrystalDiskMark Read (MB/s)	1,798	1,760.8	2,919.2
CrystalDiskMark Write (MB/s)	1,715	1,754.9	1,533.4

A good value entry gaming PC that should last you a while but could be a little brighter.
★★★★☆

$199 | www.tendacn.com/au/

Tenda 4G09 Wi-Fi 4G+ LTE Router

Tenda's 4G router is outstanding value if you're after the basics.

We reviewed our first Tenda Wi-Fi device a few months ago. It was mesh system most notable for the fact it was available from Officeworks and, subsequently, could be purchased on a whim (or in an emergency) when shopping-around wasn't an option. Now here's another Tenda device and this one will be available primarily via **amazon.com.au**. It's a dual-band, AC1200 router that uses 4G as the primary internet source.

It resembles a kind of robot rabbit, replete with bunny-ear antenna. We slotted a full-sized SIM-card into the bottom, powered it on and it worked. Even in a world where Wi-Fi set-up has become a 'few-click' process – thanks to well-designed apps – Tenda wins the simplest set-up award for basically having no set-up. It just works. There's not even a password on the default Wi-Fi network. For those desperate for internet access at a remote office or event, this will appeal when you have more important things to do than mess around with Wi-Fi set-ups.

If you want to set a password, you navigate to **www.tendawifi.com** where you're presented with a set-up page that allows you to password-protect both the network and device's administrator log-in. Once done, you can access the router's settings using a basic, browser window. This allows you to disable mobile data, enable overseas roaming and adjust performance tweaks like beamforming, signal strength and anti-interference. The performance tweaks don't come with detailed descriptions but they can be turned on and off when troubleshooting.

SPECS
Speed: Dual Band AC 1,200Mbps | Connectivity: 2 Gigabit LAN, 1 x 4G full-sized SIM | Features: Parental controls, VPN, text messaging.

You can also send and receive text messages, schedule overall internet access and guest network access (plus bandwidth). Parental controls allow you to schedule access for different devices and assign whitelisted or blacklisted websites. There are point-to-point VPN tunnelling options, TR069 remote device management, monitoring tools, alongside the usual router features. They're not as well labelled or explained as with phone apps but are all easily accessible for those who need them. All in all, there's a full complement of mobile office settings for both casual and more-serious users.

4G performance will depend almost entirely on the local 4G network you're attached to and is limited to 300Mbps down and 50Mbps up. There are also two Gigabit Ethernet ports which allow it to be used as a regular router too. We used these to test the performance of the Wi-Fi network using our standard tests of downloading videos from a Synology DS1019+ NAS to a Wi-Fi 6-equipped Dell XPS 15 OLED.

Up close it managed an excellent 392Mbps, one floor up this dropped to 30Mbps while two floors up it dropped to 23Mbps. These are impressive figures for a small AC router and the best we've seen from a 4G router – D-Link's 4G was similar up close and one-floor up, but couldn't maintain a connection two floors up.

Up to now we preferred TP-Link's MR600 but at $350, despite offering better manageability through a cleaner interface, it comes across as very expensive in the face of Tenda's $199 price tag. So, if you need a decent 4G-capable router, right now our recommendation is to buy the 4G09.

NICK ROSS

Quick and simple to get up and running, powerful features plus a low price tag make it a winner..

★★★★☆

apc RECOMMENDS

$729 | www.asus.com/au

Asus ROG Crosshair VIII Hero

Potent yet pricey.

Traditionally the ROG Hero line of motherboards has been aimed at the mid to high-end gamer. Whether that's with Intel or AMD, usually you can see these floating around the $400-$500 mark. The current one we're reviewing? $730 at the time of writing. That's a lot of cash to drop on a motherboard, and it's honestly hard for us to swallow. Even taking a step back in time for a moment, on launch the X470 Crosshair VII Hero was $379. Sure, X570 is more complex to produce than previous iterations, and there is PCIe 4.0 to consider, which we've been told since the beginning is far more advanced and therefor more expensive to manufacture, but can you really justify a price increase of $350 over the course of a year for what's advertised as a mid-range product?

Now, there's no denying that this thing is a well-equipped board. You've got memory support for up to 128GB of DDR4 with a maximum frequency of 4,800MHz, two PCIe 4.0 M.2 slots both with integrated heatsinks, eight SATA 6Gb/s ports, support for RAID 0, 1, and 10, an impeccable BIOS as always and a ridiculous amount of rear I/O on top of all that.

SPECS
Chipset/Socket X570 / AM4; Max memory support 128GB (4x32GB) @ 4800 MHz; Storage support x8 SATA, x2 M.2 PCIe 4.0; PCIe support: x2 PCIe 4.0 x16 (x8x8); Form factor ATX; Rear I/O 11x USB 3.2 Type A, 1x USB 3.2 Type C, Intel Gigabit Ethernet, 2.5G Ethernet, 5.1 Audio Out, Optical Audio Out.

It also looks impeccable. Asus really has nailed it with its designs over the years, and despite its perhaps poor first showing when AMD originally debuted its X370 chipset way back in 2017, the company's team-red offerings have certainly matured since that point. The subtle branding, the diagonally cut lines, the use of color, heatsinks, and armor really help to accentuate the overall look of the board quite dramatically.

As for performance? Well on the whole, and perhaps unsurprisingly, the Crosshair VIII Hero does really well. In Tech ARP's X264 we saw a figure of 43.3fps, Cinebench R15 hit an impressive 2,172 points, and Fry Render managed to complete in 1:58. Power draw was also fairly well-balanced, with it drawing 59W at idle and 152W under load, with some impressively low overclock figures too – no doubt in part thanks to its 14+2 design.

On the whole this is a very good motherboard. Connectivity is impressive, it has a strong amount of rear I/O, the aesthetics are exemplary, and the performance is in line with what we'd expect from an X570 mobo. However, no matter how you look at it, we just keep falling back to that price point again. Regardless of your thoughts on PCIe 4.0, $730 is just a huge number for this product's legacy. The Hero has been known as being middle of the road – not medium range, not high end – and to see it's price climb further up the scale really does make us question what Asus's ambitions are here. If we're honest, this should be the Crosshair VIII Code, a non-waterblocked variant of the company's flagship Formula board, with the former currently absent. Then perhaps apply the Hero name to the ROG Strix Gaming-F, or something along those lines. Is that pedantic? Well yes, it is, but it would certainly eliminate the confusion for the consumer.

ZAK STOREY

Indicates best result

	Asus ROG Crosshair VIII Hero	MSI MEG X570 Ace
Tech ARP's X264 (fps)	43.3	42.3
Cinebench R15 Multi (index)	2,172	2,100
Fry Render (m:s)	1:58	1:57
AIDA64 Memory Latency (ns)	74.9	75.4
CrystalDisk QD32 Sequential Read (MB/s)	4,997	5,001
CrystalDisk QD32 Sequential Write (MB/s)	4,452	4,440
Power Draw Idle/Load (Watts)	59 / 152	60 / 155
Total War: Warhammer II (fps)	58	58
Lowest Voltage @ 0000GHz (Volts)	1.07	1.07
Maximum OC achieved (GHz)	4.3 @ 1.08	4.3 @ 1.09

Good connectivity, strong performance and impressive aesthetics, but the price hike hurts.

★★★★☆

$379 | logitechg.com

Logitech G915 TKL Wireless Gaming Keyboard

Unrivaled wireless design with gaming-ready low-profile switches.

For some, less is more when it comes to their gaming or work space. Less clutter, fewer cables means more space on your desk for moving your mouse or having a snack. The Logitech G915 TKL wireless gaming keyboard frees up space in multiple ways, including a tenkeyless design that saves space by dropping the numpad and G macro keys. It also brings an ultra-slim build and the option to connect via Bluetooth or a wireless USB Type-A dongle.

The G915 TKL is a near replica of the full-sized G915 Lightspeed. That means it embodies the same svelte, classic and mature tone, with a layout thoughtfully designed for the functionality gamers need.

The first thing you'll notice is that the G915 TKL doesn't have a numpad or the programmable and side-flanked G macro keys that the full-sized version has. But at 368 x 150 x 22mm, the G915 TKL will save you horizontal desk space. You still get three easily accessible profiles stored in the keyboard's memory and the ability to do on-the-fly macro recording (you can do it via software too), but these are secondary functions of the F1 - F4 keys instead of dedicated soft buttons, like on the G915 Lightspeed.

SPECS
Switches Low Profile GL (Tactile, Clicky or Linear); Lighting per-key RGB; Interface USB Type-A wireless dongle, Bluetooth, USB Type-A cable; Dimensions 368 x 150 x 22mm; Weight 810g.

A lot of the premium features on the full-sized version appear on the tenkeyless keyboard, including buttery soft media keys and a ribbed, never-ending volume wheel that glides like it's on ice. Part of what you're paying for is the G915 TKL's durable, polished build. In an ultrathin, but dense, frame, an aircraft-grade aluminium alloy top plate sits atop a steel-reinforced plastic base that's subtly textured. Logitech's LightSync RGB pops on the brushed-metal finish. Handily, you get dongle storage on the back, as well as two sets of flip-out feet for elevating the keyboard either eight degrees or four degrees. The G915 TKL may very well be the most expensive peripheral to hit your gaming den, but it'll certainly look the part too.

The G915 TKL comes with Logitech's low-profile GL mechanical switches, either tactile, clicky or linear ones (the same options available with the full-sized version). According to Logitech, its tactile GL switches are best for competitive and first-person shooter gaming, while the linear ones are great for MMO and action games.

After hours using the G915 TKL, gaming or otherwise, I never experienced a dropout with the wireless dongle, even with my PC also running dongles for my gaming headset and mouse. The keyboard uses Logitech's proprietary Lightspeed wireless dongle technology that's supposed to offer a "pro-grade" wireless connection. The G915 TKL charges over the included Micro USB to USB Type-A cable, and Logitech claims it can go from 0-100% battery in under four hours and last 40 hours on a charge.

Whether you're looking for a keyboard that can travel to LAN parties, to work or just from one room or PC to another, the Logitech G915 TKL is as good as it gets. Its easily swappable Blueooth or wireless dongle connections make it fit for using with multiple PCs, and its tenkeyless form trims down an already slender build even more. With looks, reliability and functionality, the G915 TKL is the ultimate small-form-factor wireless gaming keyboard.

SCHARON HARDING

With a slim but sturdy, portable frame and the option to easily switch from PC to PC, it's the premium wireless tenkeyless for mechanical enthusiasts who can afford it.

★★★★☆

$389 | steelseries.com

Steelseries Apex Pro

The life magnetic, with *APC*.

Steelseries's Apex keyboards are all respectable offerings – high-quality peripherals for the discerning PC enthusiast. Each model has a dinky display and textured wheel for multimedia controls, and the same degree of overall design polish. But the Apex Pro brings something more than build quality and RGB lighting; it offers an end, finally, to the key-switch debate.

Mechanical or membrane? Linear or tactile? Clicky or quiet? The arguments may rage across reddit forever, but Steelseries has provided the answer with the new OmniPoint mechanical switch. This switch already ticks all the boxes for performance, with an incredibly fast 0.7ms response time an actuation point below 1mm, but here's the kicker: the Apex Pro's OmniPoint keys (which includes the entire main keyboard block, save the function keys, arrow keys and numpad) can be easily adjusted on a per-key basis by the user.

Thanks to magnetic sensors inside each switch, the actuation point of every key can be tuned between 0.4mm and 3.6mm; if you're not familiar with key switches, that's the distance the key must be depressed before it registers a response. 0.4mm is staggeringly low, requiring barely a fingertip resting against the key to register input. It's simple enough to replicate the feel of most common mechanical switch types – such as Cherry MX Red, Brown or Blue – using the custom actuation, so it's easy to recommend this keyboard to just about anyone.

The Apex Pro uses a simple scale for adjusting this. For regular computer use, we found that a lower actuation of two or three worked fine, resulting in a very comfortable typing experience. For gaming, though, setting that scale to seven or above proved useful. The ability to differentiate between keys here is fantastic. We took it for a spin in Riot Games's new twitch shooter *Valorant*, reducing the actuation all the way down to the minimum for the movement keys, and raising it for the ability keys.

It played like a dream; running, crouching, and jumping felt smooth as silk. These magnetic switches are also surprisingly quiet, a far cry from the noisy clattering of some mechanical keyboards. As gaming keyboards go, the Apex Pro is up there with the best of them.

SPECS
Switch type OmniPoint adjustable mechanical switch; Connection dual USB 2.0 w/ passthrough; Dimensions: 40 x 436 x 139mm.

Looking to the outer design, it's a sleek affair all round. There's very little flab here; the whole upper panel of the keyboard is cut from a single sheet of aluminum, making for a simplistic but very durable frame. Steelseries has trimmed any fat around the edges, giving this full-size keyboard a surprisingly compact feel.

Every Apex keyboard comes with a tiny OLED smart screen in the upper-right corner. Accompanied by a broad scroll wheel and a lone button, this pixel display shows anything from key-switch actuation sliders to lighting controls for your current Spotify song. It's a nifty, innovative inclusion that we found ourselves using often.

The Apex Pro retails at $390 – certainly a lot of money for a keyboard, even one as good as this. It simply *is* worth the price, though; it's been a long time since a keyboard has made us as excited as this with its cutting-edge aesthetic and awesome performance.

CHRISTIAN GUYTON

Adjustable actuation; durable build; slick media controls. Very expensive though.

★★★★½

AMD Ryzen 3 3100 - $175 | AMD Ryzen 3 3300X - $205 | www.amd.com

AMD Ryzen 3 3100 and Ryzen 3 3300X

The new budget champions?

Remember that time just a couple of years back when a quad core CPU was regarded as high end? How far things have come! The new Ryzen 3 3100 and 3300X bring 4-core/8-thread computing to the masses. Along with 10th Generation 4c/8t i3's, serious multi-threading power will now be found in all but the very cheapest PCs. The bar has been raised.

Zen 2-based Ryzen 3000 processors launched in July 2019, with the range slowly filling out over the following months. Curiously, AMD hadn't address the low end of the market until now, with discounted Ryzen 2000 series and the Zen+ APUs filling this market segment. That's all changed with the release of the $175 Ryzen 3 3100 and $205 Ryzen 3 3300X. Straight up, they offer a stunning blend of price and performance.

Introducing the Ryzen 3 3100 and Ryzen 3 3300x

The Ryzen 3 3100 is for now the entry level Zen 2-based model. This means all of the architectural benefits and features from Ryzen CPUs all the way up to the 3950X have trickled down, along with the benefits of the 7nm manufacturing process. The 3100 is a 4-core/8-thread CPU that comes with a 3.6GHz base clock and a 3.9GHz boost clock. Its four cores and 16 MB of L3 cache are divided over two core complexes which together make up a single die. It has a 65 W TDP, and also ships with a capable, if not earth shattering Wraith Stealth cooler. It will handle the 65 W 3100 just fine, but won't give you much in the way of OC headroom. Speaking of overclocking, like all the other Zen 2 processors, it's got an unlocked multiplier so you're free to OC with ease, as long as you keep it cool.

The Ryzen 3 3300x is clocked a little higher with a 3.8GHz base clock and a 4.3GHz boost clock. These clocks alone mean the $205 3300X can get very close to the higher end models when presented with lightly threaded loads. It differs from the 3100 in one important way under the hood though. Where the 3100 uses a 2+2 topology (two cores per core complex, or CCX), the 3300X packs all of its cores into one CCX, or 4+0. This means that inter core and cache communication is inherently faster with the 3300X, meaning lower latency and better clock-for-clock performance compared to the 3100. This, along with its higher clocks, means the 3300X should have a decent lead over the 3100, particularly when presented with latency sensitive applications like gaming.

SPECS AMD RYZEN 3 3100
Socket AM4; 4 Cores, 8 Threads; 3.6GHz Base Clock, 3.9GHz Boost Clock; 16 MB L3 Cache; 65W TDP; DDR4-3200 Memory Support, Wraith Stealth bundled cooler.

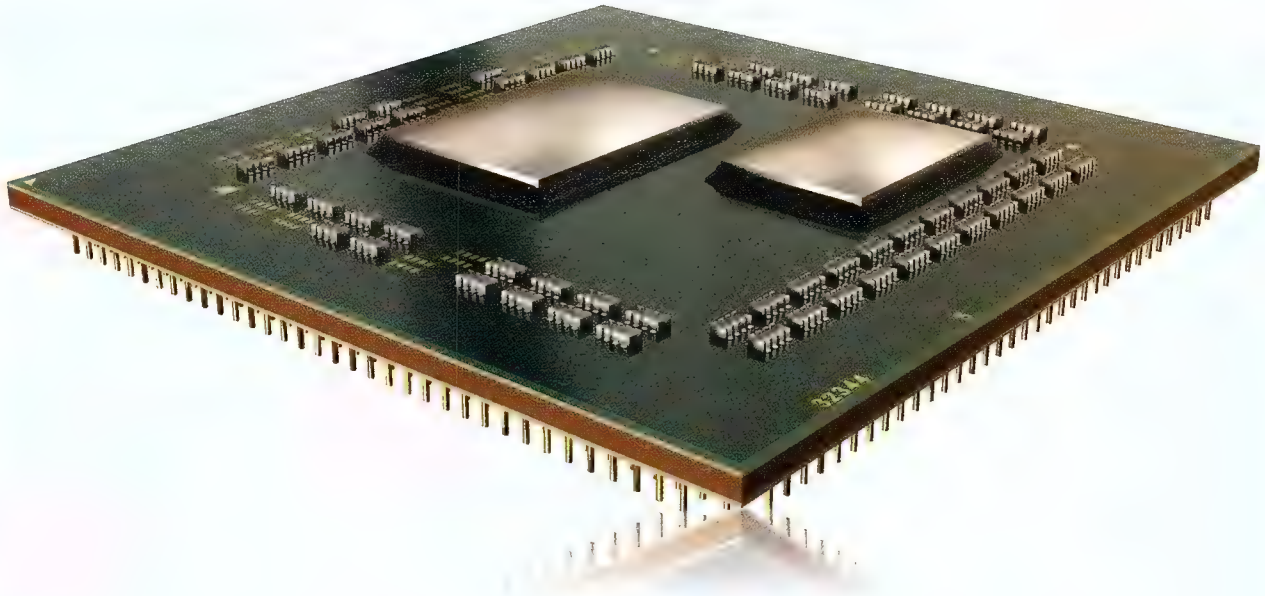
AMD RYZEN 3 3300X
Socket AM4; 4 Cores, 8 Threads; 3.8 GHz Base Clock, 4.3GHz Boost Clock; 16 MB L3 Cache; 65W TDP; DDR4-3200 Memory Support, Wraith Stealth bundled cooler.

"The Ryzen 3 3300x is clocked a little higher with a 3.8GHz base clock and a 4.3GHz boost clock. These clocks alone mean the $205 3300X can go very close to the higher end models when presented with lightly threaded loads."

Performance that resets the budget CPU marketplace

The performance on offer from the 3100 and 3300X is nothing short of excellent in this price range. With multi-threaded workloads, the efficiency of the Zen 2 architecture comes to the fore, with both Ryzen 3 models going to toe-to-toe with 8th and 9th generation i5 processors.

When presented with lighter loads, both are still competitive and only fall behind the higher clocked Intel processors, which are



typically much more expensive. Gaming remains a strength of Intel, but at this price you're not likely to be using a $1,000+ GPU, meaning gaming performance will be GPU-limited, the 3100X and 3300X will not hold you back at all when using an appropriate graphics card.

We also note the 3300X manages to pull ahead of the 3100 by quite some margin in many of our tests. While the higher clock speed explains some of this, it also points to the greater efficiency of the 3300X topology, with its latency advantages coming to the fore.

Power consumption is also very good, with an all core peak of just 61 W for the 3100 and 73W for the 3300X. Not bad at all. Temperatures too were pretty good, but not fantastic given our relatively strong 240mm AIO cooler, with a peak of 69c for the 3100 and 72c for the 3300X. A 3300X under heavy AVX load will stress the Wraith Stealth.

Ideally we'd like to have tested the 10th Generation i3 processors against the Ryzen 3 models, but we weren't able to source one. Given the recycling of the Skylake architecture though, by testing the 4c/8t Core i7 6700K, we know what kind of performance to expect from the mostly similar i3-10300.

Suprisingly overclockable

We usually don't gain much when overclocking Ryzen processors and tend to recommend leaving them at stock. The 3300X surprised us though. Our sample was able to hold an all core bench stable overclock at 4.4GHz with 1.3v. Pushing higher than this voltage resulted in instability. Perhaps we'd see better results on a different board with more power options available.

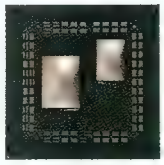
"We usually don't gain much when overclocking Ryzen processors and tend to recommend leaving them at stock. The 3300X surprised us though. Our sample was able to hold an all core bench stable overclock at 4.4GHz with 1.3v."

The 3100 was only a little lower than this, with 4.375GHz possible with all cores loaded. Given that the 3100's Turbo clock is 3.9GHz, getting close to 4.4 is very nice indeed and represents the biggest all core percentage overclock we have seen with any Ryzen processor to date. We're excited to see what AMD can do with its Zen 3 processors now that it seems the 7nm process is maturing.

What's not to like?

Both the Ryzen 3 3100 and 3300X redefine the budget CPU market. The combination of great performance, low price and power efficiency make them easy to recommend, though we'd recommend going for the slightly more expensive 3300X for most users, and particularly for gamers. The only downside is that we'd like to see integrated graphics in this price range, but you'll have the option for that with the upcoming Zen 2 APUs. Stay tuned for them.

Other than losing out on the core count compared to the more expensive models, the Ryzen 3 models don't really omit much else. You still get all the I/O features including 24 PCie 4.0 lanes, DDR4-3200 memory support and an unlocked multiplier. Wouldn't it be nice if Intel gave us an unlocked i3!



AMD is leveraging its chiplet architecture to produce these CPUs .

They're a perfect match with a B450 or a B550 motherboard (if you must have PCIe 4.0 support), both of which support overclocking. Speaking of which, finally we can recommend having a go at overclocking a Ryzen CPU. It's finally worth it! If you are going to tinker with OC though, you may want to invest in better cooling. The Wraith Stealth can best be described as adequate. Even a mid-range air cooler will be vastly superior.

Intel's i3 CPUs provide competition, but they're also priced significantly higher. For now the 3100 and particularly the 3300X are the new budget CPU kings.

CHRIS SZEWCZYK

The 3300X and to a lesser extent the 3100 offer tremendous performance that redefines the budget CPU market.

AMD Ryzen 3 3100

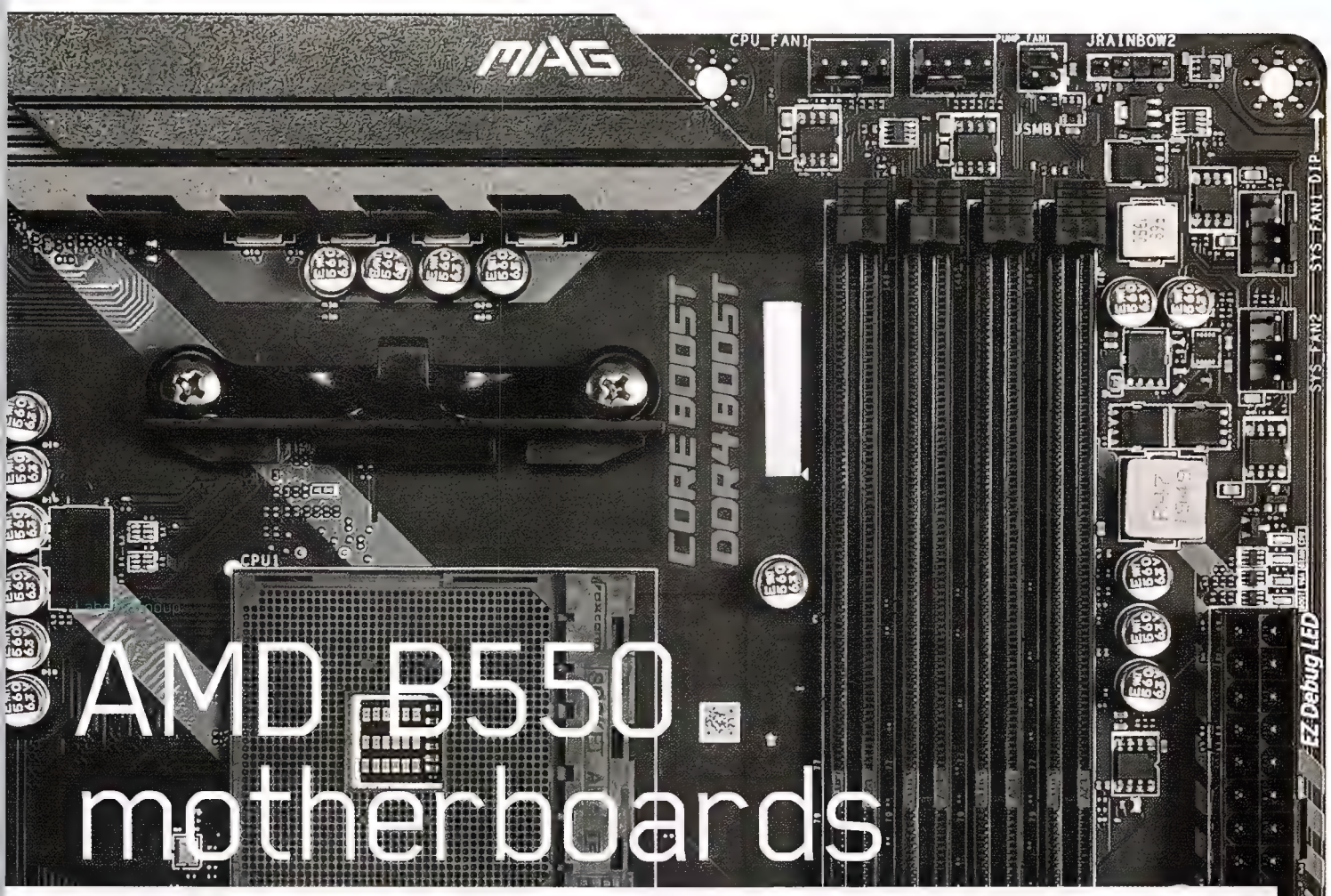
★★★★☆

AMD Ryzen 3 3300X

★★★★★

AMD RYZEN 3 3100 AND RYZEN 3 3300X BENCHMARK RESULTS

Indicates best result		Intel Core i7-6700K	Intel Core i5-8400	AMD Ryzen 5 3400G	AMD Ryzen 5 3600	AMD Ryzen 3 3100	AMD Ryzen 3 3300X
X264 v5.0 Video Encoding	Pass 2 Avg FPS	19.31	21.15	18.72	33.04	22.23	23.97
Cinebench 20	Multi thread Score	2,140	2,282	1,975	3,527	2,349	2,575
Cinebench 20	Single thread Score	427	398	337	460	437	499
Blender 2.79 BMW Render	Time (seconds) Lower is better	502.9	492.0	529.2	312.5	488.0	437.8
7Zip	Million Instruction per second	27,642	27,998	23,943	45,481	30,546	34,429
POV-Ray	Ray Tracing - Pixels Per Second	1,864.3	2,291.5	1,883.5	3,227.0	2,143.7	2,330.3
CPU-Z	Multi Thread Score	2,297.7	2,542.5	2,489.3	4,036.0	2,617.7	2,847.4
CPU-Z	Single Thread Score	439.3	444.3	461.7	506.4	475.0	515.0
SiSoft Sandra	Aggregate Memory Bandwidth (GB/s)	35.60	33.85	34.54	35.28	36.44	36.60
Handbrake Video Encoding	4K 10-Bit HEVC to 1080p FPS	38.8	45.2	36.6	52.9	43.8	44.5
Peak Power Consumption	Watts	83	59	65	79	61	73
Load temp	Celsius					69	72
AS SSD	Sequential Read	2,759.4	2,783.2	2554.8	2834.5	2,882.1	2,892.8
AS SSD	Sequential Write	2,433.5	2,504.1	2380.2	2518.6	2,521.5	2,514.5
AS SSD	4K Read	55.2	56.2	50.1	60.2	59.3	58.8
AS SSD	4K Write	162.2	175.4	152.1	206.8	204.4	205.4
3DMark TimeSpy Extreme		5,196	5,450	4833	5,820	5,173	5,292
3DMark TimeSpy Extreme CPU		2,280	2,584	1861	3,261	2,206	2,373
Civilization VI	1080p, Ultra, DX12, Avg FPS	140.7	157.5	128.5	169.6	130.1	158.1
Civilization VI	1080p, Ultra, DX12, Min FPS	107.8	129.8	98.8	136.6	104.0	123.7
Civilization VI	1080p, Ultra, DX12, AI Turn Time	6.57	6.43	6.87	6.32	6.66	6.53
Ghost Recon Wildlands	1080p, Low, Avg FPS	146.0	185.4	147.0	194.6	165.6	178.1
Metro: Exodus	1080p, Ultra, DX12, Avg FPS	100.5	100.1	77.8	97.3	88.9	99.3
Metro: Exodus	1080p, Ultra, DX12, Min FPS	56.3	55.3	45.2	52.3	48.9	50.4
Middle Earth: Shadow Of War	1080p, Lowest Preset, Avg FPS	193	208	153	204	167	201
Far Cry New Dawn	4K Ultra Preset Avg FPS	77	78	69	77	75	77
Far Cry New Dawn	4K Ultra Preset Min FPS	65	66	53	65	57	65
3DMark TimeSpy		10,907	11,692	10,774	12,484	11,140	11,240
3DMark TimeSpy CPU		5,163	5,578	4,479	4,134	4,897	5,036



AMD B550 motherboards

Chris Szewczyk examines AMD's feature packed but not-so-budget B550 chipset.

The launch of 3rd generation Ryzen alongside X570 motherboards brought AMD many well deserved plaudits, but that success has mostly been restricted to the enthusiast segment. Until now there's been no way to buy into 3rd generation Ryzen without spending several hundred dollars for a Ryzen 5 3600. We've been waiting for more affordable 3rd generation options and that time is now here. With the launch of B550 motherboards and quad core Ryzen 3000 series processors, mainstream buyers can now build systems that offer levels of performance, connectivity and I/O that promise to shake up the 'budget' end of the PC market.

Note the inverted commas around the word budget. B550 is something of a curious beast. Motherboard pricing across all Intel and AMD product lines has taken a large step upwards. COVID-19 and the typical new product premium can't be the only reasons for this. Some B550 boards are priced well into premium territory with only a handful of options available below $200. A board such as the B550 Aorus Master we're reviewing here's costs $439. We're hoping that in time there will be many more decent options priced well below $200.

B550 boards are certainly better than B450 boards. Many have improved VRM capabilities and cooling, which was a definite weakness of some B450 boards. The headline is support for PCI Express 4.0, opening up support for faster NVMe storage options along with current and future PCIe 4.0 GPUs. Whereas B450 supported PCIe 2.0 general purpose chipset lanes, B550 supports PCIe 3.0. X570 boards feature PCIe 4.0 chipset lanes. This is the major difference between X570 and B550. B550 motherboards do have an advantage over X570 boards in that they don't require active chipset cooling.

B550 is a very important product line for AMD and the motherboard vendors. Apart from the forthcoming low-end A520 chipset, it's likely B550 will end up being the final mainstream chipset before the launch of the AM5 socket. It's set to be the optimal chipset to be paired with AMD's forthcoming 'Renoir' Zen 2 APUs, and B550 will likely have a place in the market for some time to come.

A quality B550 board will accept everything from a low end 3100 to a next generation hypothetical 16-core 4950X. Note that B550 is not compatible with 2000 series Ryzen processors or 3000 series APUs primarily due to firmware size limitations.

Upcoming Zen 2-based APUs are also supported, hence the presence of HDMI 2.0 or 2.1 and/or DisplayPorts on many boards. A Zen 2-based Renoir APU and a B550 motherboard should be a compelling combination and one we look forward to testing.

We've selected a variety of B550 boards that cover many mainstream use cases. You could go for an all-out overclocked gaming rig with a Ryzen 9 CPU, a small form factor living room PC or a simple but powerful work machine. Whatever the use case, there's a B550 motherboard to suit. Read on as we take a look at some tasty motherboards that will be right at home in your current and future PC, with Ryzen 4000 series support adding extra peace of mind.

"B550 is a very important product line for AMD and the motherboard vendors. Apart from the forthcoming low-end A520 chipset, it's likely B550 will end up being the final mainstream chipset before the launch of the AM5 socket."

$399 | www.asrock.com

Asrock B550 Phantom Gaming ITX/ax

Asrock, ITX and B550 are made for each other, but at a price.

As the name suggests, the Asrock B550 Phantom Gaming ITX/ax is a mini-ITX motherboard, the sole such entry in our roundup. The mini-ITX form factor has a loyal following and B550 ITX boards should sell well as they are suited to the lower power characteristics of the Ryzen platform.

Being a mini-ITX board, you'll always have a lack of PCB real estate to fit heaps of extras in, but surprisingly the little Asrock competes well against the bigger boards. You still get dual M.2 slots, though only the primary slot is equipped with a heatsink. The other slot is on the back side of the board. Asrock managed to include the premium ALC1220 audio codec, though surprisingly there's no optical output on the rear panel. The little Asrock also includes addressable RGB, four SATA ports and a welcome USB 3.2 Gen 2 Type-C case header.

The Asrock PG ITX doesn't have the strongest VRM you'll ever come across, but it's still an 8-phase design with 90a stages powered by an 8-pin power connector. It will run any CPU you care to throw at it, but its relatively small heatsink will need good airflow if it's not to get too hot if you push it hard.

The rear I/O is fairly standard and comes with the shield preinstalled. We'd like to see more than six USB ports as three or four can often be taken up straight away by the likes of a keyboard, mouse, printer or external HDD. Six USB could imply some sort of PCB limitation as other premium B550 ITX boards are limited to six too. We're happy to see Intel i225V 2.5 GbE really penetrating the lower end of the market along with Wi-Fi 6. We like to see both DP 1.4 and HDMI 2.1 ports for use with the upcoming Zen 2 APUs.

We've always been fans of Asrock's modern UEFI interface. The B550 PG ITX isn't massively loaded with options, but all the core ones you care about are easily accessible. Don't forget to give AMD's ECO mode a try sometime if your CPU or VRM temps get a bit high over summer.

"It will run any CPU you care to throw at it, but its relatively small heatsink will need good airflow if it's not to get too hot if you push it hard."

SPECS
Socket AM4; Support for 3rd & 4th Generation AMD Ryzen processors; 2x M.2; 4x SATA; up to 3x USB 3.2 Gen 2, 6x USB 3.2 Gen 1, 2x USB 2.0; 802.11ax 2.4Gbps Wi-Fi; 1x HDMI 2.1, 1x DP 1.4; Intel I225V 2.5G LAN; Realtek ALC1220 7.1 Channel HD Audio; Mini-ITX Form Factor.

The little Asrock was a bit of a mixed bag in our testing, though as always the differences are small enough to not be a concern. It isn't particularly fast at multicore rendering and encoding type work with our 3700X but it did excel with our SSD bandwidth testing and was the fastest in all AS-SSD tests. Well done. Gaming performance too was competitive with the other boards in the roundup.

The Asrock PG ITX has a RRP of $399 which puts it at the high end of the B550 market. At this price it's going up against the premium ATX boards, and it costs more than competing ITX boards from Asus and Gigabyte. Asrock's reputation for excellent value has deserted it in this case. Early pricing aside, it's actually a very well appointed ITX board and with its advertised Ryzen 4000 series support, we could see it being the last AM4 ITX board you'd ever buy. Let's just hope the pricing matures and it becomes a better bang for buck option.

Asrock's ITX prowess is on full display here, but its current pricing hurts it in a competitive market.

★★★½☆

apc HOT PRODUCT

$279 | www.asus.com

Asus TUF Gaming B550M Plus (WiFi)

A well-equipped mATX B550 entrant that's surprisingly affordable.

It's nice to see fans of mATX get some love! Asus' TUF brand has expanded to include partnerships with many different manufacturers who sell products to match the yellow tinged aesthetic. Though we wouldn't call it a particularly attractive board, it has a rather understated and subtle appeal that users opposed to RGB lightshows will appreciate. It also offers very good value, something we don't always see from Asus.

The mATX form factor means PCB space isn't as limited as it is with mini-ITX, but with M.2 slots taking a lot of room, the PCB is still quite packed with components. The SATA ports are of the vertical variety, and there's a pair of RGB headers if they're of interest to you. There are a pair of M.2 slots, one of which supports PCIe 4.0, while the other supports PCIe 3.0 and is connected via the chipset. Strangely, the PCIe 3.0 slot is the one that is equipped with a heatsink, a curious decision when it's the topmost slot that is most likely to be used. The positioning of the secondary slot under a potentially hot GPU partly explains it.

SPECS
Socket AM4; Support for 3rd AMD Ryzen processors; 2x M.2; 4x SATA; up to 2x USB 3.2 Gen 2, 6x USB 3.2 Gen 1, 6x USB 2.0; 802.11ax 2.4Gbps Wi-Fi; 1x HDMI 2.1, 1x DP 1.2; Realtek 8125B 2.5G LAN; Realtek ALC1200A 7.1 Channel HD Audio; mATX Form Factor.

"Though we wouldn't call it a particularly attractive board, it has a rather understated and subtle appeal that users opposed to RGB lightshows will appreciate."

The B550M TUF features an 8+2 phase VRM powered by a single 8-pin power connector. Two large and hefty heatsinks help to keep it all cool. It might not be what you'd call an extreme VRM solution, but for the price it's perfectly adequate, capable of powering a high-end Ryzen CPU without issue. The heatsinks look big but there's actually quite a lot of empty space underneath them, so you'll still need to pay attention to your airflow if you plan to use a high core count CPU and/or overclock.

The rear I/O is quite good, Eight USB ports are welcome compared to the bare six on the MSI and Asrock boards. You also get Wi-Fi 6 and Realtek 2.5 GB Ethernet along with HDMI 2.1 and a single DisplayPort (1.2 instead of 1.4). This makes it a good candidate for pairing with an upcoming Renoir APU.

The Asus B550M TUF performed admirably during our testing, consistently at the top of the pack, or near to it across all CPU and bandwidth based testing. It's a similar story when it comes to gaming with the Asus putting up a strong showing. Very good!

Asus is known for its comprehensive BIOS implementations. There's not the complexity that can overwhelm some ROG users, yet the TUF BIOS contains all the useful settings you could need. Asus deserves a shout out for its fan controls. Along with MSI, Asus' hysteresis and custom fan curves are typically top notch.

We came away quite impressed with the Asus TUF Gaming B550M Plus Wi-Fi (that's a mouthful!) At $279 it still isn't what you'd call a cheap board, but compared to other equivalent B550 boards, it's very affordable especially with the features on offer. These include a decent quality VRM, 2.5GbE, Wi-Fi 6 and a good I/O selection. Throw in its strong performance and we're left with a highly positive opinion of the Asus TUF Gaming B550M Plus Wi-FI. Thumbs up!

Asus' B550M TUF is a well appointed board that offers excellent value and performance. mATX fans take note.

★★★★★

$439 | www.aorus.com

Gigabyte B550 Aorus Master

A luxurious B550 that makes some X570 motherboards look positively bland.

Say hello to the Gigabyte B550 Aorus Master. It might ostensibly be based on a budget chipset, but this is no budget-oriented motherboard at $439. One look though and you'd never mistake it as such. You wouldn't be alone in assuming that this was a good quality X570 board.

As expected, the Aorus Master easily features the best specification in the lineup. There's plenty of fan and RGB headers, six SATA ports, debug LED and Gigabyte's audio implementations are usually impressive like the one here. In the past Gigabyte really went all out on the RGB lighting, but this is a much more tasteful and mature design. Perhaps we have passed peak RGB!

It's the only board in the roundup to feature three M.2 slots, all of which are equipped with heatsinks. Three M.2 slots isn't a standard B550 feature and to achieve this the Aorus Master uses an interesting trick. If you use either of the bottom two M.2 slots, the primary PCIe slot drops back to 8x. This is still the equivalent of a 16x PCIe 3.0 slot, so we're not too concerned about that. The B550 Master's M.2 design erases the most significant limitation of the B550 chipset, which is the ability to run multiple PCIe 4.0 NVMe drives.

The quality of the VRM design really stands out. It packs in a genuine 16-phase 70a digital VRM powered by 8-pin and 4-pin power connectors. This is a board capable of powering any Ryzen CPU, whether it's an overclocked 3950X or any future 4th Gen CPU. It's cooled by Gigabyte's trademark finned heatsink for maximum surface area and cooling efficiency. Top shelf stuff! Some X570 boards could learn a thing or two from this design.

The rear I/O is packed with loads of USB ports. There are no less than six USB 3.2 Gen 2 ports (including one Type-C) and another six USB 2.0. Very impressive, although at this price a Gen 2x2 port would be welcome. At this level we'd like to have seen the inclusion of a DisplayPort and perhaps an additional LAN port, though with the inclusion of Wi-Fi 6, a second LAN port won't be a deal breaker for all but a few users. There's a reason that all those $500+ X570 boards exist!

"It's the only board in the roundup to feature three M.2 slots, all of which are equipped with heatsinks."

SPECS

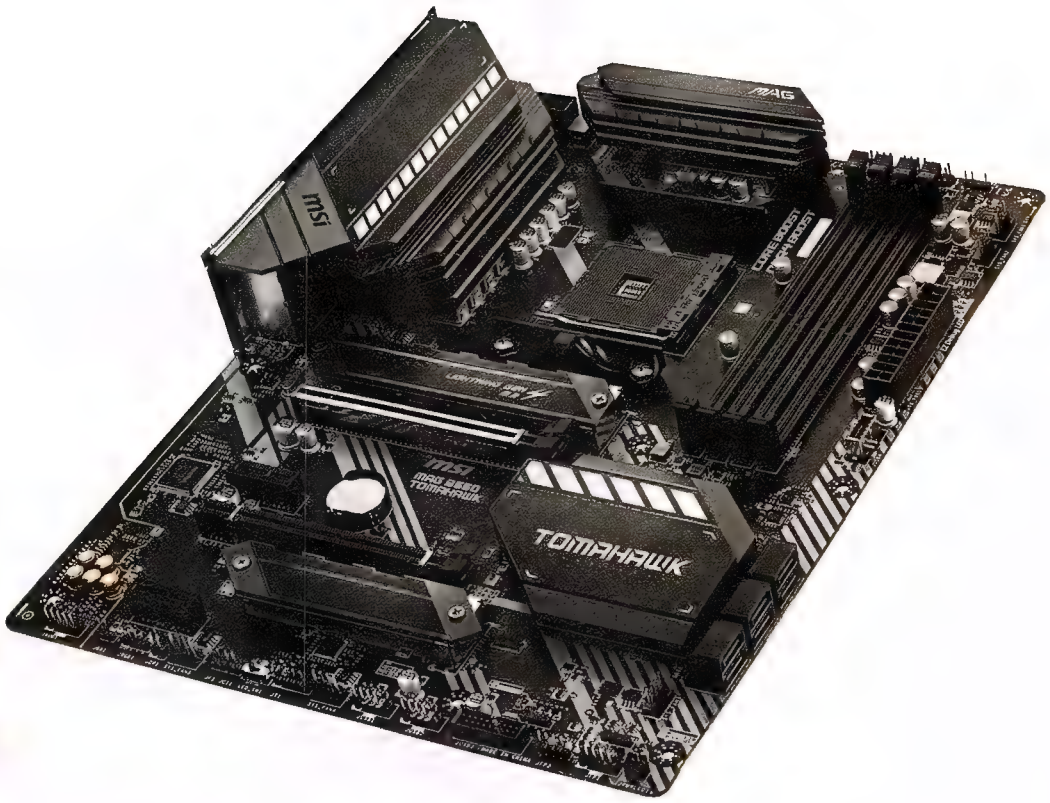
Support for 3rd AMD Ryzen processors; 3x M.2; 6x SATA; up to 6x USB 3.2 Gen 2, 3x USB 3.2 Gen 1, 10x USB 2.0; 802.11ax 2.4Gbps Wi-Fi; 1x HDMI 2.1; Realtek 8125B 2.5G LAN; Realtek ALC1220 7.1 Channel HD Audio; ATX Form Factor.

The Aorus Master performed as expected, though perhaps a tiny bit behind in a few too many tests. We often talk about how motherboard benchmarking usually doesn't reveal too much, and anything within a one or two percent margin won't show up anywhere but in benchmarks.

As we mentioned in the introduction, the Gigabyte B550 Aorus Master is one of the most expensive of all B550 motherboards at $439, but it does pack features that wouldn't be out of place on more expensive X570 boards. You get a hugely powerful VRM capable of heavy overclocking, load of USB ports, 2.5GbE and Wi-Fi6 and 3x M.2 slots (though with an asterisk as explained above). If you're after a premium B550 motherboard, there's not many that pack in more features than this. It's a board that makes some more expensive X570 boards look cheap in comparison.

The Aorus Master makes some X570 boards look rather basic though at $439, budget it isn't.

★★★★½



apc RECOMMENDS

$309 | www.msi.com

MSI MAG B550 Tomahawk

A utilitarian offering without the bells and whistles.

At $309, MSI's MAG B550 Tomahawk is a reasonably priced ATX B550 entry. It's priced far below the luxuriously appointed Aorus Master but it's hardly a barebone budget board. The B550 Tomahawk comes across as a no frills type of board. The design and presentation is rather unassuming. You won't see it on display in an all out water-cooled show rig, but you will find it powering plenty of gaming rigs. Like the impression you get from a burbling V8 at low RPM, the Tomahawk's got it where it counts.

The B550 Tomahawk has two M.2 slots, both of which feature heatsinks, and the second one is thoughtfully placed away from the hot air of a GPU. It's got six SATA ports, plenty of fan headers along with RGB and a welcome USB Type-C header. The latter is a feature that's increasingly gaining traction.

"It's easily capable of powering any current or future Ryzen processor without breaking a sweat. It's a feature that a considerate buyer with an eye on the 4000 series processors should take note of."

SPECS
Socket AM4; Support for 3rd AMD Ryzen processors; 2x M.2; 6x SATA; up to 2x USB 3.2 Gen 2, 5x USB 3.2 Gen 1, 6x USB 2.0; 1x HDMI 1.4; 1x DP 1.4; Realtek 8215B 2.5G & 1x 8111H 1G LAN; Realtek ALC1200 7.1 Channel HD Audio; ATX Form Factor.

It seems MSI really made a concerted effort to improve its VRM implementations, both with its B550 and also recently introduced Z490 boards. The B550 Tomahawk packs in a 10+2+1 phase VRM, a single 8-pin power connector and chunky metal heatsinks. It's easily capable of powering any current or future Ryzen processor without breaking a sweat. It's a feature that a considerate buyer with an eye on the 4000 series processors should take note of.

The I/O is the area of the board that's a little underwhelming. It's the only board in the roundup not to feature Wi-Fi, though it does include a second 1G LAN port to complement the 2.5G port. We'd also like to see an extra couple of USB ports, even if they are USB 2.0 so you can connect a keyboard, mouse or printer without having to use up the valuable higher speed ports. If you need Wi-Fi, you could consider MSI's own slightly cheaper B550M Mortar Wi-Fi, but that board doesn't have a top quality VRM like the Tomahawk does. This is an example of why we think the Tomahawk is well suited to some buyers, but not all.

The B550 Tomahawk performed well in our test suite. The Asus TUF generally leads by a nose, but the Tomahawk snaps at its heels. Its NVMe performance is strong and gaming performance is also pretty good. The strong performance on offer is a factor that adds to our impression of the Tomahawk being a solid choice of board if you have no need for Wi-Fi.

The MSI B550 Tomahawk comes across as a thoughtfully engineered choice that's more performance oriented. It may not suit every buyer's needs at this price, but if your focus is on what it does offer, then you will find a lot to like. It's the kind of board you'd expect to be purring along in 5+ years' time with a next gen CPU. The lack of Wi-Fi is a drawback, but then who cares if you don't use it. This is a board to suit a buyer who wants a no bling board with a high quality VRM that's built with an eye on the future. If it ticks your particular boxes then the B550 Tomahawk is a solid choice.

The B550 Tomahawk's focus on core features and quality power delivery will suit many discerning buyers.

★★★★☆

AMD B550 MOTHERBOARD BENCHMARK RESULTS

Indicates best result

		Gigabyte B550 Aorus Master	Asus TUF Gaming B550M Plus WiFi	MSI MAG B550 Tomahawk	Asrock B550 Phantom Gaming ITX/ax
X264 v5.0 Video Encoding	Pass 2 avg FPS	43.15	43.40	43.33	43.13
Cinebench 20	Multi thread score	4,809	4,823	4,826	4,778
Cinebench 20	Single thread score	492	496	486	486
Blender 2.79 BMW Render	Time (seconds) – Lower is better	233.3	232.1	232.5	234.2
7Zip	Million instruction per second	59,259	61,763	61,026	60,788
POV-Ray	Ray tracing -pixels per second	4,301.8	4,291.8	4,274.3	4,284.9
CPU-Z	Multi thread score	5,526.5	5,566.0	5,571.1	5,558.6
CPU-Z	Single thread score	529.2	526.1	526.4	528.0
SiSoft Sandra	Aggregate memory bandwidth (GB/s)	33.90	34.00	33.78	34.00
Handbrake Video Encoding	4K 10-Bit HEVC to 1080p FPS	57.6	58.5	59.3	58.5
AS SSD	Sequential read MB/s	2,679.9	2,584.7	2,684.1	2,694.0
AS SSD	Sequential write MB/s	2,493.5	2,413.0	2,451.1	2,543.9
AS SSD	4K read MB/s	60.1	60.2	60.4	60.6
AS SSD	4K write MB/s	201.3	201.9	202.8	205.4
3DMark TimeSpy Extreme		6,307	6,318	6,322	6,310
3DMark TimeSpy ExtremE CPU		4,520	4,562	4,538	4,490
Civilization VI	1080p, Ultra, DX12, avg FPS	200.8	205.0	205.6	204.9
Civilization VI	1080p, Ultra, DX12, min FPS	152.9	155.9	155.7	155.7
Civilization VI	1080p, Ultra, DX12, AI turn time	6.31	6.21	6.40	6.17
Ghost Recon: Wildlands	1080p, Low, avg FPS	189.5	191.8	191.2	190.5
Metro Exodus	1080p, Ultra, DX12, avg FPS	99.7	100.5	99.9	100.5
Metro Exodus	1080p, Ultra, DX12, min FPS	48.2	48.5	48.2	49.0
Middle Earth: Shadow of War	1080p, Lowest Preset, avg FPS	214	216	217	216
Far Cry New Dawn	4K Ultra Preset avg FPS	77	77	77	77
Far Cry New Dawn	4K Ultra Preset min FPS	65	65	65	64
3DMark TimeSpy		13,408	13,505	13,544	13,562
3DMark TimeSpy CPU		9,725	9,858	9,983	10,001

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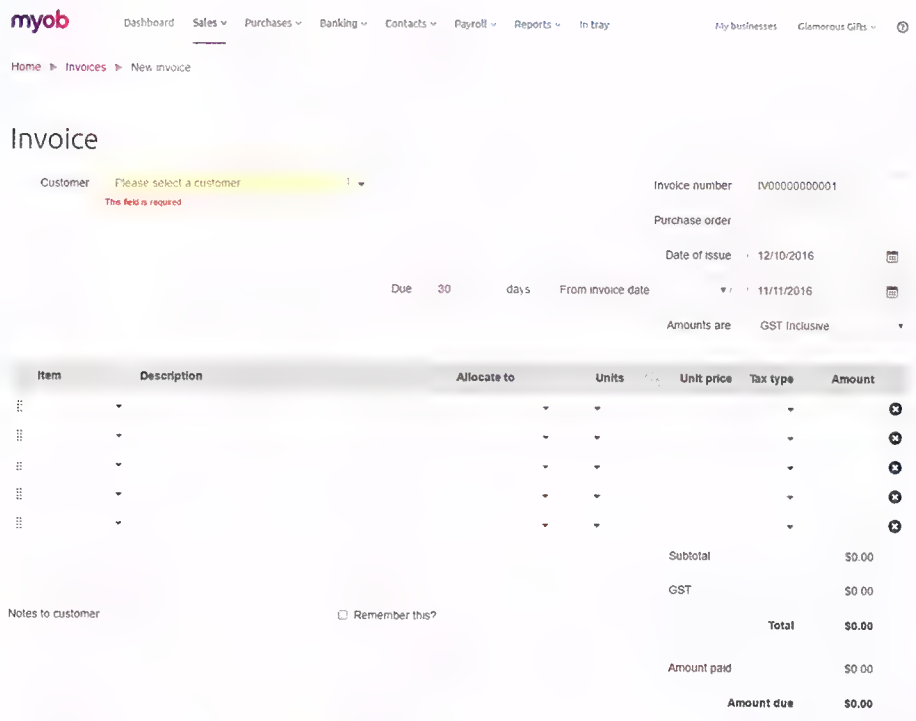
MYOB Essentials

How does this home-grown Aussie accounting platform stack up in the cloud age?

MYOB has been a dominant provider of Australian small business accounting software for decades. With the 2020 release of MYOB Essentials, you get the latest cloud-based tech in an accounting package that draws from the maker's long history of supporting SMEs. With functionality to cover micro and growing business, Essentials offers all of the key components required to remain compliant and competitive if you're doing business in Australia. The platform rolled out a new look and feel in March of this year, which new subscribers will see immediately upon registering; existing users should expect to see the upgrade rolled out to their accounts before September.

Every small business needs a strong understanding of its cash flow – ideally, you want to use a combination of bank feeds, auto-matching and rule based allocations to make the task of not only tracking your cash but accounting for your business transactions very easy. Essentials covers this base extremely well, highlighting the experience MYOB brings to this vital function. It's not quite perfect however, and while the new interface in the 2020 release of Essentials improves on the bank feed tech, dashboard cues don't clearly show the status of your bank feeds. This can be a problem if your bank feeds fail to update.

Invoices are customisable, so you can give your customers a form that's tailored to your business and style. The 'In Tray' feature is a great addition, providing a full online storage solution for your supplier invoices and documents. You can create transactions directly from an inbound email or via the MYOB Capture app, which scans the contents of the document and prefills detail like the invoice total, reference number. This streamlined process will not only cut the time you take doing the books, but stores everything in one place for easy recall.



Budget Management is a tool that will offer invaluable insights into future performance scenarios. Essentials standard report set covers a lot of bases, with a fair amount of customisation and output options. This latest update has implemented some welcome improvements in the reporting selections, which continue the clean lines of the interface into the reporting output.

"Every small business needs a strong understanding of its cash flow – ideally, you want to use a combination of bank feeds, auto-matching and rule based allocations to make the task of not only tracking your cash but accounting for your business transactions very easy."

With the backing of such a large service provider, it's perhaps no huge surprise that that MYOB is able to deliver Essentials consistently and reliably. With data hosting based on Microsoft Azure infrastructure in Australia, and a large on-call support team, you can have reasonable confidence that your important business information is always going to be safe and accessible.

Essentials has come a long way in recent years and is a polished contender in the cloud-based accounting arena. Small businesses need a tool that can streamline processes and save them time while delivering business intelligence with ease – Essentials measures up to this mark, with a solid feel and helpful, context-sensitive support throughout.
KURT BEST

Clear and concise, MYOB Essentials makes the grade for ease of use and feature richness.
★★★★☆

MACOS 10.12 or later | US$4.99 | FROM John Siracusa, hypercritical.co

Front and Center

Revive old windows behaviour.

Way back in the days before OS X, when you clicked on a window in a Mac application, all the windows for that application were brought to the front.

In OS X and now in macOS, only the window you click is brought to the front, the others remain in the background. For applications that have a separate window for each document, like Word and Excel, that's an issue.

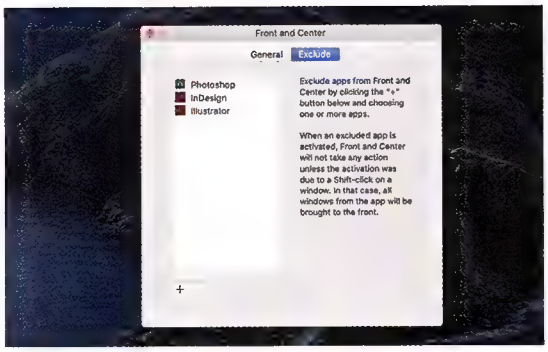
Front and Center fixes that by restoring pre-OS X behaviour and bringing all the windows in an app to the front when you click one.

Front and Center's interface is a menu bar item with two options: Classic and Modern. The former restores pre-OS X, aka classic behaviour, while the latter option reactivates the macOS window layering.

In either mode, up arrow-clicking a window will do the opposite. You can also create a list of apps to exclude from Front and Center's instruction.

And that's it, a simple, one-trick app that you'll either love or won't understand what the fuss is about. And that's the point. If you miss classic window behaviour, Front and Center is for you; if not, you can simply move along.

KENNY HEMPHILL


Front and Center
General
Exclude
Photoshop
InDesign
Illustrator
Exclude apps from Front and Center by clicking the "+" button below and choosing one or more apps.
When an excluded app is activated, Front and Center will not take any action unless the activation was due to a Shift-click on a window. In that case, all windows from the app will be brought to the front.
+

It may be simple, but Front and Center will delight many older Mac users.

★★★★☆

MACOS 10.12 or later | US$4.99 | FROM John Siracusa, hypercritical.co

BlueHarvest

Smarter shared drive.

One of our favourite things about Mac developers is that if something annoys you, a developer feels your pain too and will create an app to soothe it.

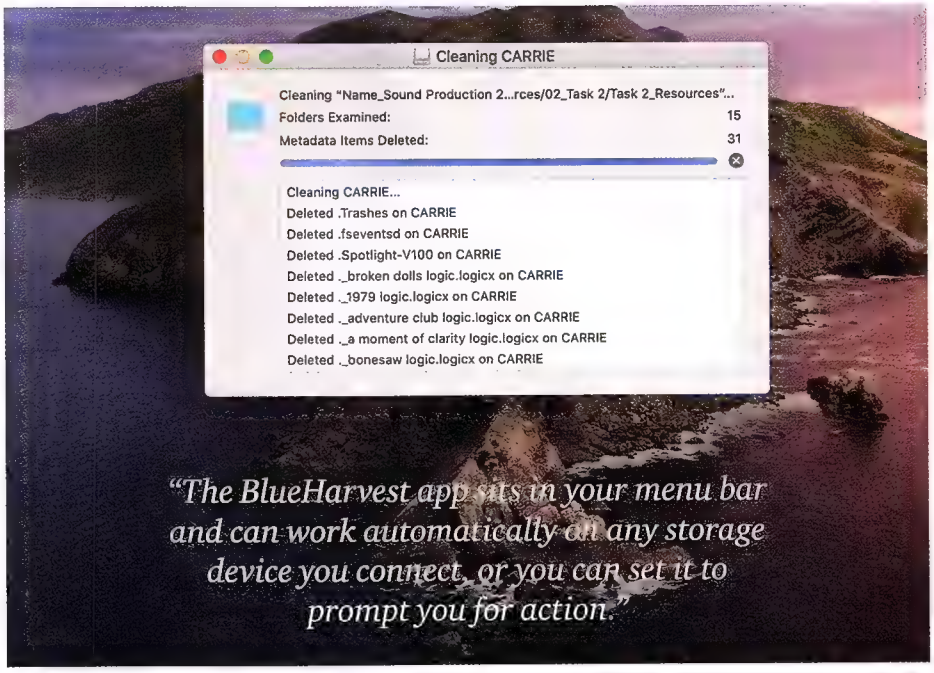
With BlueHarvest, the pain is all the stuff your Mac (or a Windows PC) leaves on external drives – vital for the OS but a pain if you're sharing content with your in-car audio or your smart TV, or if you work with PCs as well as Macs.

The BlueHarvest app sits in your menu bar and can work automatically on any storage device you connect, or you can set it to prompt you for action. It then analyses the drive and removes metadata such as ._ files, .DS_Store files and . Trashes (and, if it's been on a Windows PC, Thumbs.db and Desktop.ini).

The app works brilliantly. No more scrolling through a full suite of ._ files before we can listen to our Lana Del Rey AACs in the car; no more trying to work out which file is the video clip and which one is the Apple duplicate on our Smart TV.

BlueHarvest is quick, easy to use, has a tiny footprint, and solves something that annoys us almost every day. Metadata be gone!

CARRIE MARSHALL


Cleaning CARRIE
Cleaning "Name_Sound Production 2...rces/02_Task 2/Task 2_Resources"...
Folders Examined: 15
Metadata Items Deleted: 31
Cleaning CARRIE...
Deleted .Trashes on CARRIE
Deleted .fseventsd on CARRIE
Deleted .Spotlight-V100 on CARRIE
Deleted ._broken dolls logic.logicx on CARRIE
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Deleted ._adventure club logic.logicx on CARRIE
Deleted ._a moment of clarity logic.logicx on CARRIE
Deleted ._bonesaw logic.logicx on CARRIE
"The BlueHarvest app sits in your menu bar and can work automatically on any storage device you connect, or you can set it to prompt you for action."

An elegant solution to an annoying problem.

★★★★★

iOS 12 or later | Free (IAPs) | office.com

Microsoft Office

apc RECOMMENDS

Office goes all-in-one on iPhone.

Microsoft Office has been available on iOS for several years as individual apps, but the new Microsoft Office app is an all-in-one that combines Word, Excel, PowerPoint and Office Lens in a single app. Although it's listed as iPad compatible, it's very much an iPhone app and doesn't take advantage of your iPad's bigger screen.

The core app is free and enables you to subscribe to Office 365 in Personal or Family versions for $6.99 or $9.99 per month respectively. That upgrade doesn't affect what the Office app can do, but it boosts OneDrive storage to 1TB and unlocks power features in the main Office apps for your Mac or PC.

The app opens with a list of your available Office documents. As you would expect, Microsoft would prefer you to use its OneDrive storage, but you can also pull from your device, from the Files app, from SharePoint, or from a range of cloud services including Dropbox, Box and various business-focused services.

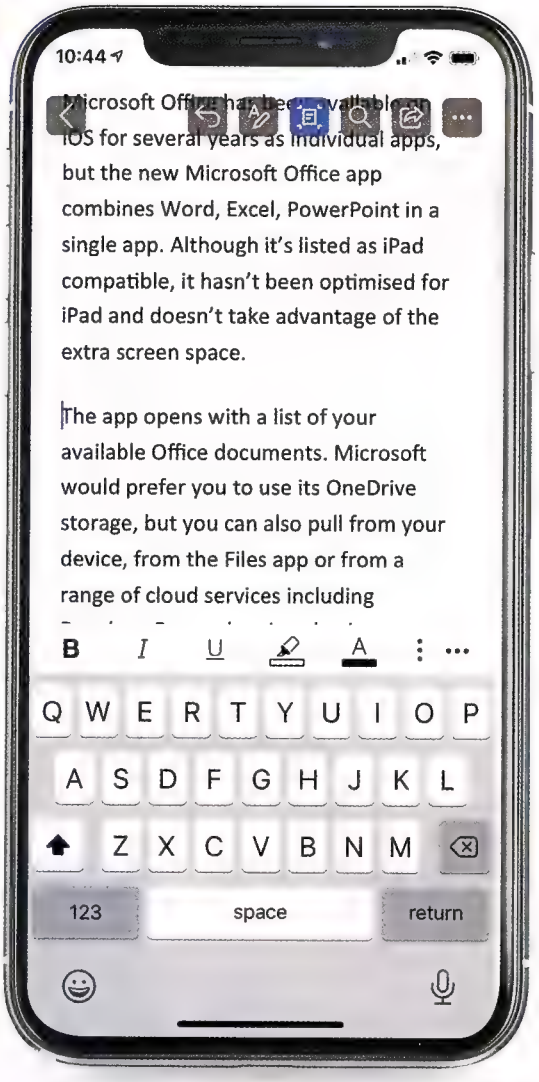
Clean interface

The interface has been stripped back considerably for iPhone, so for example in a Word document there's a single formatting strip above the on-screen keyboard and just a handful of icons in the top-right corner, including the share icon, which you can use to invite others to collaborate or simply to send a copy of the document via iOS's share sheet. The interface has clearly been designed with one-handed use in portrait mode in mind: the Excel icon strip looks particularly empty in landscape.

Fast-work features

This Office has been specifically designed for mobile working, and it includes some clever touches. Office Lens integration means you can take a photo of a document and instantly convert it to an editable Word document or Excel spreadsheet; PowerPoint can help you build a presentation

"The core app is free and enables you to subscribe to Office 365 in Personal or Family versions for $6.99 or $9.99 per month respectively. That upgrade doesn't affect what the Office app can do, but it boosts OneDrive storage to 1TB."

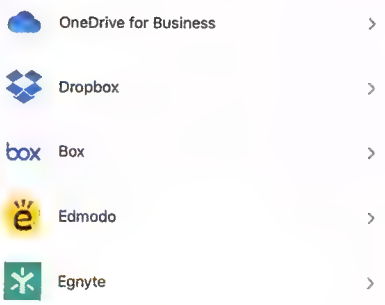

10:44
Microsoft Office has been available on iOS for several years as individual apps, but the new Microsoft Office app combines Word, Excel, PowerPoint in a single app. Although it's listed as iPad compatible, it hasn't been optimised for iPad and doesn't take advantage of the extra screen space.
The app opens with a list of your available Office documents. Microsoft would prefer you to use its OneDrive storage, but you can also pull from your device, from the Files app or from a range of cloud services including
B I U A
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
123 space return

Your Word documents can be used in iPhone mode (as shown here) or in print mode.

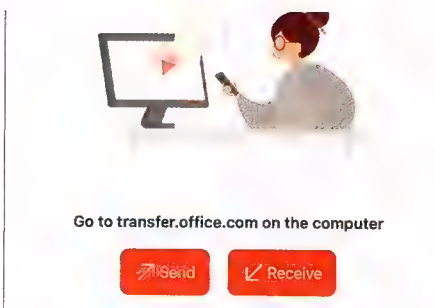
HOW TO: Get stuff done with Office in your pocket

The great firewall of china, or:
REGULATION IS HARD
Many foreign sites banned, including Google.com, YouTube and Twitter.
No common carrier defence
Active policing and reporting of online opinion
100,000s of workers employed in censorship

Office Lens' whiteboard mode makes it easy to snap screens and scribbles, and it corrects and straightens pics for you.



Add cloud storage services to your list of places: on the Home screen, tap the folder icon and select Add A Place.



As PCs don't have AirDrop, to send files to Microsoft Office send the PC to **transfer.office.com** and snap its QR code.

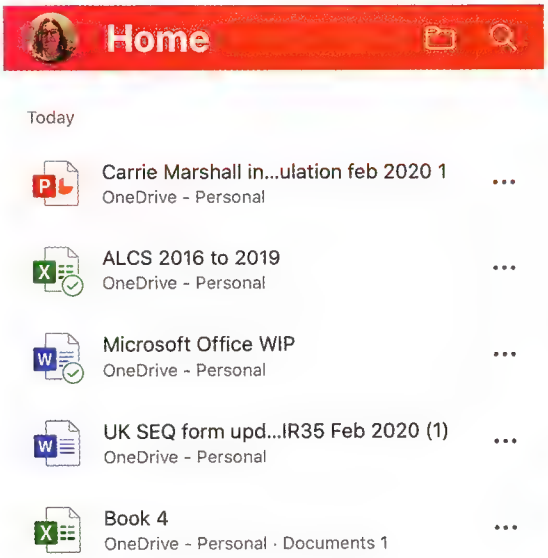
based on the photos you select from your Camera Roll; and you can snap and enhance whiteboards during meetings or lectures. The app can open links from QR codes, create PDFs from photos or Office documents, and enables you to sign PDFs with your finger. The app also handily integrates Microsoft's Sticky Notes for written or handwritten notes and scribbles.

The Office interface gets out of your way so you can focus on what you're doing.

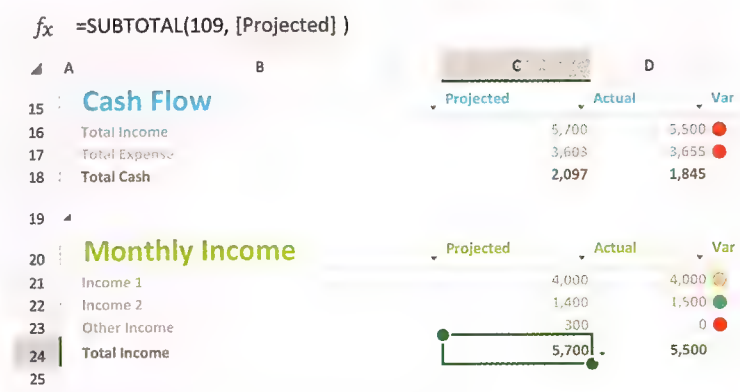
The all-in-one Microsoft Office is not designed to replace the existing apps for iPadOS: it hasn't been optimised for iPad and says so when you first run it, recommending the individual apps instead. It's not much fun on iPad as it's too small at normal size and too bulky if you scale it up, and we'd much rather use the full-fat versions for document, spreadsheet, and presentation work. But for accessing and quickly dealing with Office documents on the move, capturing bits of useful information and enabling you to quickly work on ideas, Office does a good job. It also does it with a much smaller footprint than the existing apps: Office is 377MB compared to 880MB for the individual apps combined.
CARRIE MARSHALL

Having all of your Office files in one place is a big time-saver on your mobile device.

Good for capturing ideas and dealing with things on iPhone, but not great on iPad.
★★★☆☆



"Office Lens integration means you can take a photo of a document and instantly convert it to an editable Word document or Excel spreadsheet; PowerPoint can help you build a presentation based on the photos you select from your Camera Roll."



The streamlined interface is apparent in every element.

"Not only does Copwatch allow you to record interactions but it also will let you set up safety contacts to alert them to your location."

ANDROID | Free

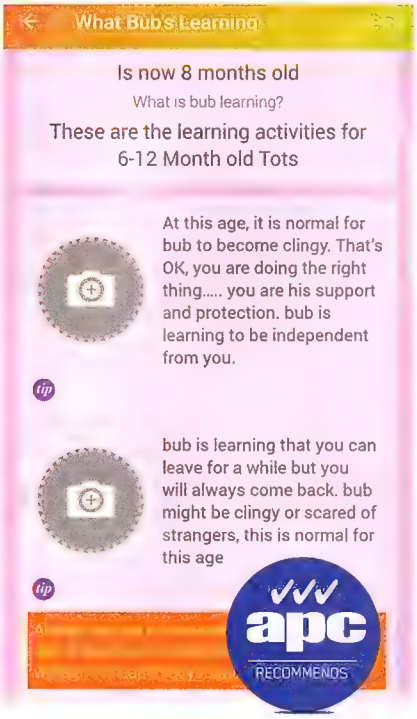
Copwatch

Know your rights.

Around the world we are seeing police brutality brought to light and this is largely thanks to footage shot on phones. I can't recommend enough that everyone has an easy method for this purpose because as we've seen, it can happen to anyone. Unfortunately, it happens to our First Nations people more than any other, which is exactly why Copwatch was made. Not only does Copwatch allow you to record interactions but it also will let you set up safety contacts to alert them to your location. It also offers helpful information about your rights when recording and interacting with police and advises people to seek counsel before sharing any video. The aim is to make police accountable and empower people to know their rights while remaining safe. You'll need to set up your own cloud backup, though, as the videos don't upload anywhere. I understand why, but it does seem like a slight oversight given the importance of what's being recorded and the potential for them to be destroyed.

★★★★☆

"It focuses on telling you what your child would be learning at that age, how they process emotions, and what they need from you during that time."


What Bub's Learning
Is now 8 months old
What is bub learning?
These are the learning activities for 6-12 Month old Tots
At this age, it is normal for bub to become clingy. That's OK, you are doing the right thing..... you are his support and protection. bub is learning to be independent from you.
tip
bub is learning that you can leave for a while but you will always come back. bub might be clingy or scared of strangers, this is normal for this age
tip
apc
RECOMMENDS

ANDROID | Free

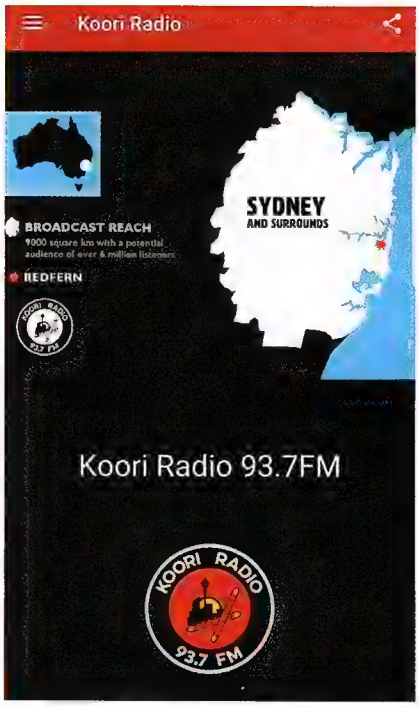
Deadly Tots

Family matters.

I don't have kids, and this is in no small part due to how daunting I believe that would be. I wanted to check out Deadly Tots because it has good reviews and an app designed specifically around raising children through a First Nations perspective sounds excellent. However, what really enamoured me to Deadly Tots is it has a real emphasis on love, stories, and family. I created a few fake children and the advice was always clear without sending me into a headspin. It focuses on telling you what your child (real or otherwise) would be learning at that age, how they process emotions, and what they need from you during that time. You can also upload pictures that correlate to that age and learning period to look back on, which creates a beautifully contextual memory book that you can even print out. Plus, It also tells you what kind of health things to look out for, when to go for health checkups, and cultural calendar events.

★★★★☆

"You'll hear a lot of local music that might not have otherwise reached your ears and really good conversations from the perspective of First Nations people."



Koori Radio

Turn it up.

ANDROID | Free

The next time you're looking for a new jam to listen to, download Koori Radio and let it show you the way. As far as apps go it's a super basic little radio player without many options but it does give you a nice clear broadcast from Sydney's only First Nations radio station. There's a section that lets you check Facebook and its website to see upcoming programs but they're just inbuilt browser links. Instead, it's all about the content. You'll hear a lot of local music that might not have otherwise reached your ears and really good conversations from the perspective of First Nations people. As I write this I'm getting a new perspective from some genuinely likeable Kiwi women of colour hosting the current segment. It's an easy way to get educated, find new tunes, and generally listen to some different voices. Again, the app itself is a bit basic and underwhelming but the station is more than worth your time.

★★★☆☆

Regolith Linux 1.4

Jonni Bidwell has found his true calling: to bring tiling window managers

Regolith Linux has the goal of "reducing unnecessary clutter and ceremony" from the desktop. This piqued our interest because (a) frankly we can't stand unnecessary pomp and ceremony and (b) Regolith uses the i3 window manager on top of Gnome. It's a wild combination. Why? Tiling window managers, and i3 in particular, are hard to get to grips with.

You may have seen screenshots of hardcore Linux users' desktops with translucent, titlebar-less terminals with razor-thin borders, the characteristic i3 status bar displaying tens of Emacs-ridden workspaces and stock prices, and Conky on the desktop displaying local weather and system resource usage. You can set all that up on any minimal Linux distro. However, it takes time and patience… lots of patience. And then, when you've got everything looking just right you'll find that doing 'normal' desktop things, such as browsing the contents of a USB stick or connecting to a VPN, requires installation of comparatively bloated programs or libraries from KDE or Gnome.

It's possible to do all those things from the terminal and script them to suit your workflow. But that's not really satisfactory. Oh, and we haven't even mentioned it's quite hard to get one's head around the tiling window philosophy, wherein even if a single window is open on the desktop, then it's maximised, obscuring your personality-defining desktop background. And then there's the fact that everything is very much keyboard-driven, so new users will find themselves clicking and dragging hopelessly on things that don't respond to clicks and drags. Stuff of nightmares.

Best of both worlds

Enter Regolith, which bundles i3-gaps (as we noted in our Pop review, having gaps between tiled windows makes things much less claustrophobic for beginners) together with just the bits of Gnome required to make the desktop usable to mere mortals, namely the Settings application, display manager and a friendly file manager. Regolith defies i3's design of having the user set absolutely everything up by applying sane defaults and adding in i3xrocks for populating the aforementioned status bar. There's also the Rofi applications menu and window switcher (which you summon with Super-space, there's no button), which works much like Pop's pop-up menu.

So it's nice that Gnome's GUI file manager and other core applications are there to offer some creature comforts. The distro fits into a tidy 1.2GB ISO and the initial install (which uses Casper to provide the same experience as Ubuntu) occupied the same. Behind the scenes it uses Gnome Flashback, the less CPU-taxing shell for Gnome. So this is ideal for more modest hardware. A floating menu provides a handy crib sheet for keyboard shortcuts (and there are a lot), and they're all arranged into five cascading menus. You'll want to hide this (Super-shift-?) because sooner or later, small and well-meaning though it is, it will get in your way.

Regolith's look can be tweaked with varying granularity. At the high level, install a "look" to provide a uniform theme, or at the low level you can mess with configuration files for each component. And you have a choice of not one but three window compositors, opening up a whole world of transparency tweaking.

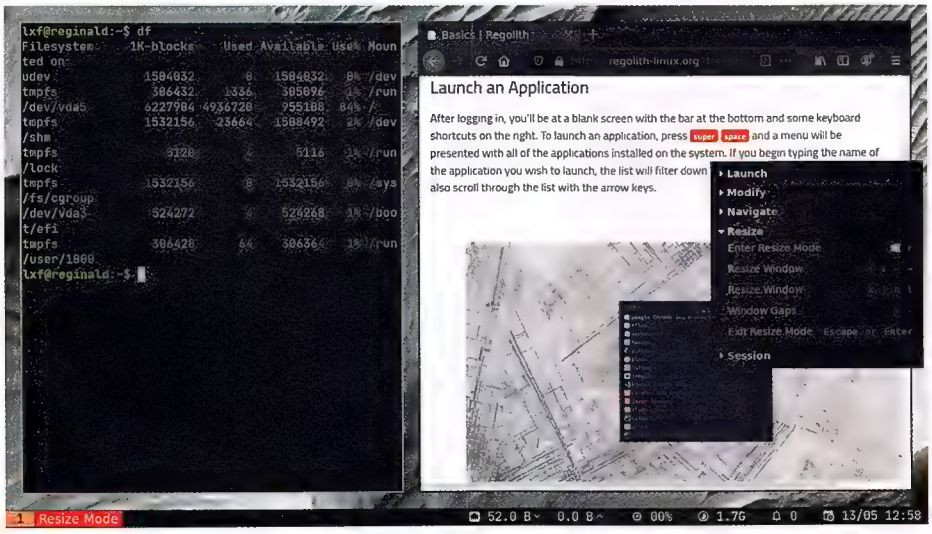
Let's be straight. This isn't going to be for everyone. There is excellent documentation and help is on hand through the community Slack channel. What Pop!_OS did was admirable, introducing tiling but still allowing users the crutch of using the mouse. But those rodent habits must be shed in order to fully embrace the tile style. And if you can manage that, then you might never look back.

JONNI BIDWELL

Possibly the most gentle introduction to a real tiling window manager set up this side of the galactic portal.

★★★★☆

"Behind the scenes it uses Gnome Flashback, the less CPU-taxing shell for Gnome. So this is ideal for more modest hardware."


lxf@reginald:~$ df
Filesystem 1K-blocks Used Available Use% Mount
ted on
udev 1584032 0 1584032 0% /dev
tmpfs 386432 1336 385096 1% /run
/dev/vda5 6227904 4936720 955188 84% /
tmpfs 1532156 23664 1508492 2% /dev
/shm
tmpfs 5120 4 5116 1% /run
/lock
tmpfs 1532156 0 1532156 0% /sys
/fs/cgroup
/dev/vda3 524272 4 524268 1% /boo
t/efi
tmpfs 386428 64 386364 1% /run
/user/1000
lxf@reginald:~$
Basics | Regolith
regolith-linux.org
Launch an Application
After logging in, you'll be at a blank screen with the bar at the bottom and some keyboard shortcuts on the right. To launch an application, press super space and a menu will be presented with all of the applications installed on the system. If you begin typing the name of the application you wish to launch, the list will filter down also scroll through the list with the arrow keys.
Launch
Modify
Navigate
Resize
Enter Resize Mode
Resize Window
Resize Window
Window Gaps
Exit Resize Mode Escape or Enter
Session
Resize Mode
52.0 B 0.0 B 00% 1.7G 0 13/05 12:58

Resizing windows with the keyboard is at first like writing with your non-dominant hand.

BUILD IT

The WD Editor Box

Master modder Stuart Tonks once again graces *APC*'s pages with another sumptuous custom build – which you could win!

Wind back the *APC* clock a year and you will have seen the very special modded PC built by pro-modder Stuart Tonks, and made possible by WD. It was a stunner, and we gave it away to a very happy *APC* reader. And now, we're doing it again!

Stuart has gone in a different direction with this build and it's aimed ostensibly at video editors – but, really, is simply a powerhouse able to tackle anything, including gaming. Once again, we are running a competition to give this beauty away; see the boxout for details on how to enter. We are quite sure that whoever can call this their own will be very happy indeed!

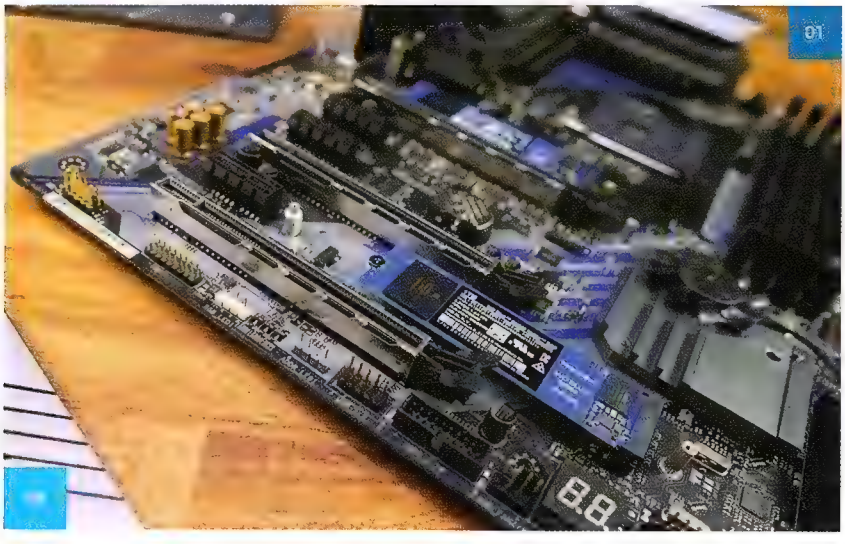
Here, Stuart shares in his own words how he came to choose the final design, and the components that went into it. Perhaps we can all learn a thing or two from this for the next build we do ourselves.

Planning and design

For an editing PC, there are a few things that need to be taken into consideration before rushing out and choosing your favourite parts. When it comes to building any PC really, planning is a very important process and often overlooked. Whether it be a gaming system, custom liquid-cooled monster or even just a home office PC, planning should never be overlooked. Most of the time you'll be building the system for yourself so you know exactly what you'll be using the PC for. But for this project, Western Digital reached out to me to build a high-end editing PC to showcase the new WD Blue SN550 NVMe SSD. Because this PC is also to be given away to an *APC* reader, things are made rather tricky without knowing the winner and their exact use case. I also feel that even though this project is for an editing system, the winner may also use the system for other tasks like gaming and so on. 01

The final design I went with is a beasty editing specced system with a bit of flair. It not only looks good, it has the ability for some late-night gaming or even just processing huge files. The days have gone of having an ugly black box sitting under the desk. As the PC is not for me, maintenance and upgradability have also been kept in mind, so we won't be seeing a full custom water loop in this one.

STUART TONKS Stuart has been leading the way in the Australian modding scene for years, and has won many awards for his creations. See more of Stuart's modding at **ggflan.com**



"The final design I went with is a beasty editing spec'd system with a bit of flair. It not only looks good, it has the ability for some late-night gaming or even just processing huge files."

What's in the box?

There's no shortage of computing power and capability with this PC.

Top-spec components abound, and being backed by Western Digital the storage in particular is generous and speedy, to say the least.

The star of the show is the WD Blue SN550 NVMe SSD, which we reviewed back in *APC* March 2020, and awarded it a stellar 5/5, describing it as "the best mainstream NVMe SSD on the market right now." With two 1TB WD Blue SN550s onboard this beast will fly. The SN550 makes use of Western Digital's latest 96-layer TLC NAND. The use of TLC with its inherent endurance advantages over QLC means the SN550 has an excellent endurance rating of 600 terabytes written, a 1.7 million hour MTBF rating (190 years+!) backed with a five year warranty.

Chunky HDD storage comes in the form of a whopping 24TB of storage thanks to four Western Digital WD Black 6TB hard drives. As any video editor knows, you can never have too much storage – and this is a lot! The WD Blue SN550 NVMe SSD is available from **https://bit.ly/312Zng6**.

CPU: AMD Ryzen 3900X
Motherboard: Asrock X570 Creator
Memory: 32GB G.Skill 3600MHz
GPU: Zotac RTX 2080 Super Amp Extreme
Case: Fractal Design 7 White
PSU: Fractal Design Ion+ 860
CPU cooling: Fractal Design Celsius+ S36 Prisma AIO
Storage: 2x WD Blue SN550 NVMe SSD 1TB
4x WD Black 3.5-inch PC Hard Drive 6TB
TOTAL VALUE: $6,600

02

A speedy 16-core Ryzen 9 3900X is installed alongside 32GB of G.Skill 3200MHz memory.

Selecting the parts

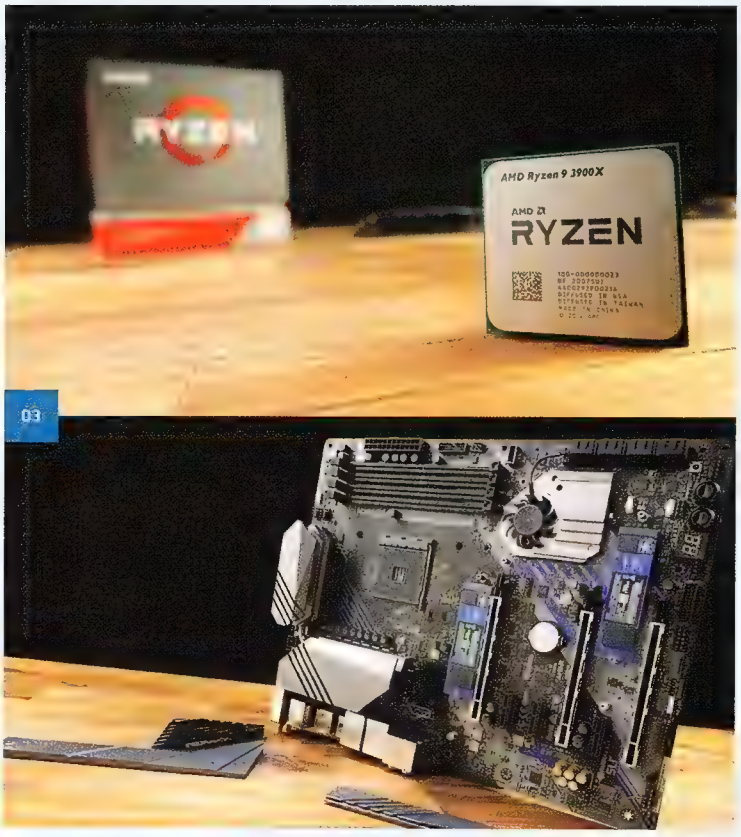
With the planning out of the way and no crazy custom water loop to spec out, I carefully selected parts that to me would give the selected winner a decent editing PC with plenty of options. The main breakdown of parts I went with includes Western Digital (of course) for all the storage needs; AMD and Asrock for the processing power and future proof connectivity; as well as Fractal Design for the chassis, cooling and powering the system. 02

I've been editing for many years now and find one of the key components for a smooth editing session is the CPU. Throwing in a Ryzen 9 3900X 16-core processor will keep this system going well into the night, and running nice and cool. For the motherboard you'll find an Asrock X570 Creator – yes, hence the name, this has everything a creator needs, 10 Gigabit networking, dual Thunderbolt 3 ports, full PCIE gen4 support, and more. 03

Storage-wise, we find there's plenty of it in Western Digital's new WD Blue SN550 NVMe SSD. Two 1TB SSDs have been installed in this system. One for a speedy OS drive while the second can be set up for a scratch drive. These SSDs boast speeds up to four times more than SATA SSDs at up to 2,400 MB/s, so they are the perfect addition for any editor or content creator who wants to upgrade their PC. As much as I love my super-fast SSDs, I'm still pretty old school and enjoy my old mechanical drives for bulk storage or backups. If the selected winner is a hardcore editor, they will need some beefy large-scale storage for backups. I've gone with four Western Digital Black 6TB drives for this. Black drives are not only incredibly fast – for mechanical drives they're also very reliable. 04

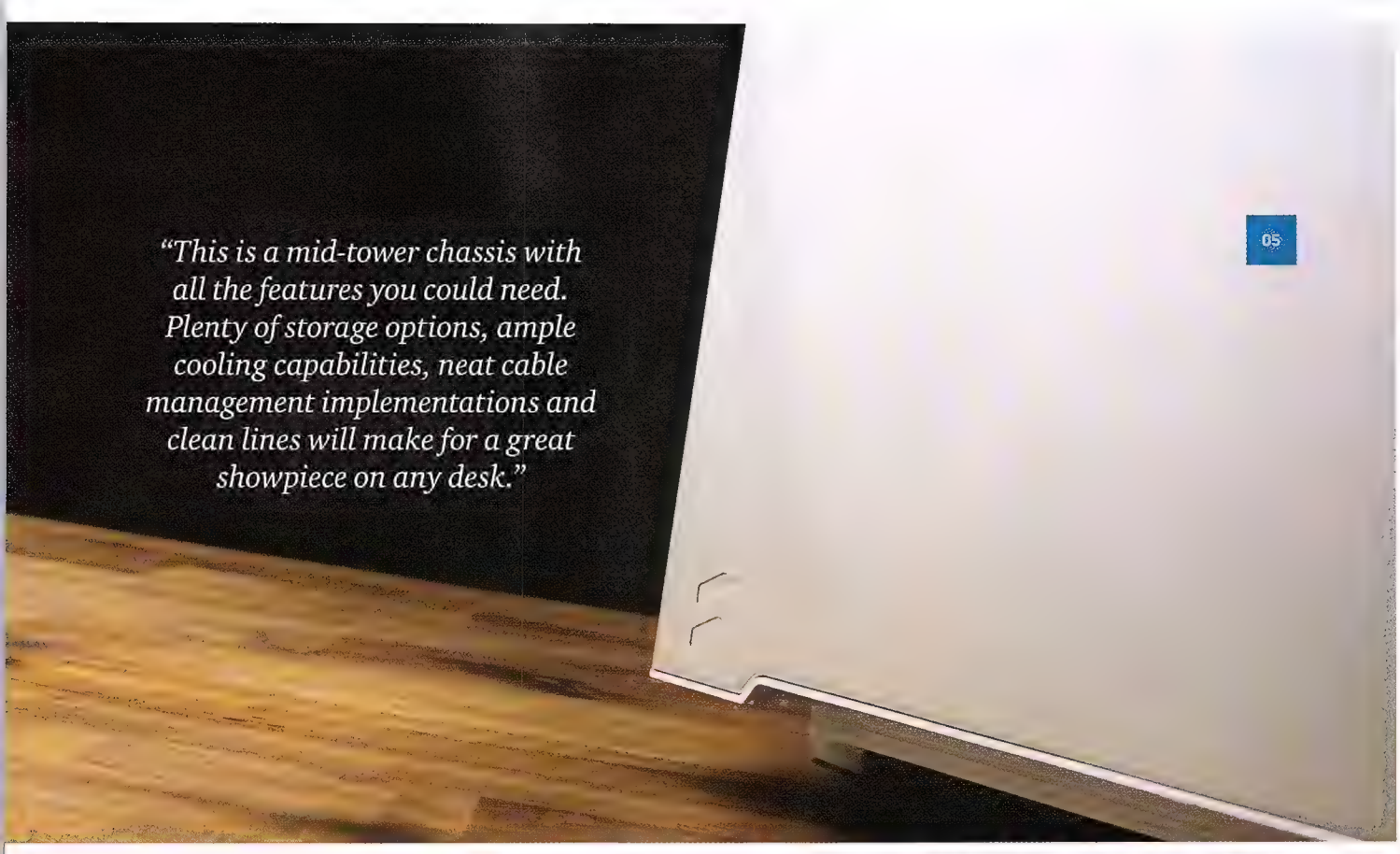
I've gone with 32GB of G.Skill

"As much as I love my super-fast SSDs, I'm still pretty old school and enjoy my old mechanical drives for bulk storage or backups."



03

04


"This is a mid-tower chassis with all the features you could need. Plenty of storage options, ample cooling capabilities, neat cable management implementations and clean lines will make for a great showpiece on any desk."
05

Trident Z RGB memory. It's 2020, so we've got to have a bit of RGB here and there. The lighting from these will tie-in nicely with the RGB fans, GPU and AIO cooler. I could have gone 64GB of memory but often find only specific editing needs will require that much. The memory installed in this system is operating at 3600MHz, which is a perfect match for the Ryzen 3900X processor.

One item that's often overlooked is the case. There are so many options out there and how do you know if it has the features you need? You've probably heard of Fractal Design – it's been building feature-packed quality cases for as long as I can remember. The Define Series has been a trendsetter since way back when it first came to market. For an editing system it was a no-brainer to go with something like the Fractal Design Define 7. This is a mid-tower chassis with all the features you could need. Plenty of storage options, ample cooling capabilities, neat cable management implementations and clean lines will make for a great showpiece on any desk. 05

While we're talking about Fractal Design, I've thrown in one of its new Celsius+ S36 Prisma all-in-one coolers. This is maintenance-free and will keep the 3900X running nice and cool – while a Fractal Design Ion+ 860W Platinum power supply is powering the whole system. 06

When it comes to video cards and editing systems it can be a bit of a mixed bag. Some software relies heavily on the CPU while other software can utilise GPU performance as well. In case the winner wanted to also use this rig as a gaming PC, I've thrown in a Zotac RTX 2080 Super AMP Extreme, which will handle the latest AAA titles with ease.

The build

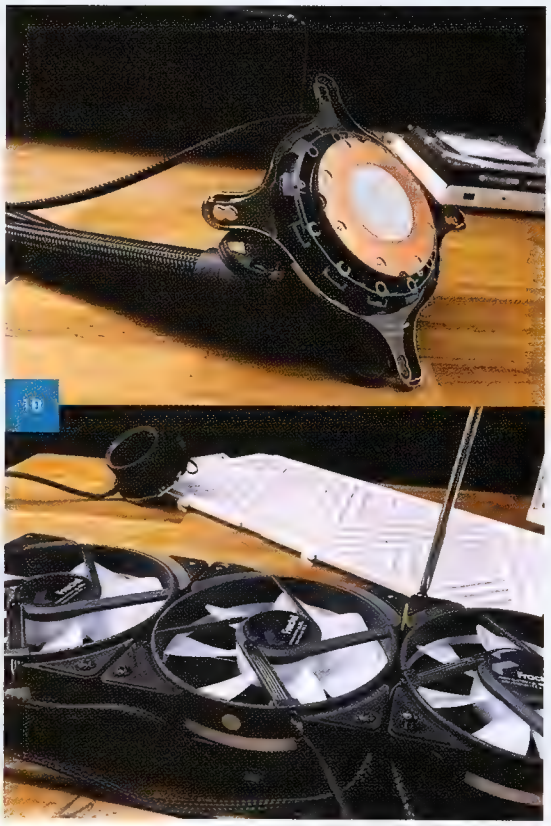
With planning and parts out of the way, it now came down to building the PC. If you've followed my work before, this build is quite straight forward when compared to what I'm used to doing. No custom water cooling or modding required for this system. But in saying that, this may not be a straightforward build for some and/or if you're a beginner in the PC building department. 07

Starting off, I always mount all the gear (or as much gear as possible) to the motherboard first. This includes, of course, the CPU, memory and the WD Blue SN550 NVMe SSDs – saving having to

reach into the case later on. Oh – make sure you mount that motherboard's IO shield into the case before mounting the motherboard! 08

The Define 7 from Fractal Design is a feature-packed case and has several use cases. Even the user's manual has instructions for setting the case up for your needs. The "Server Build" layout was exactly what I needed as this will now provide the support for the four Western Digital Black 6TB hard drives to be installed. They are pushed just enough in the case to allow the 360 AIO to be installed at the front of the chassis. 09

With the case layout set up, motherboard and drives in, the next setup was to quickly mount the AIO fans and then pop them into the chassis. As the AIO cooler is going in the front of the chassis, we need to make sure the fans are oriented correctly with them intaking air from the front. The Fractal Design Celsius+ S36 Prisma AIO uses

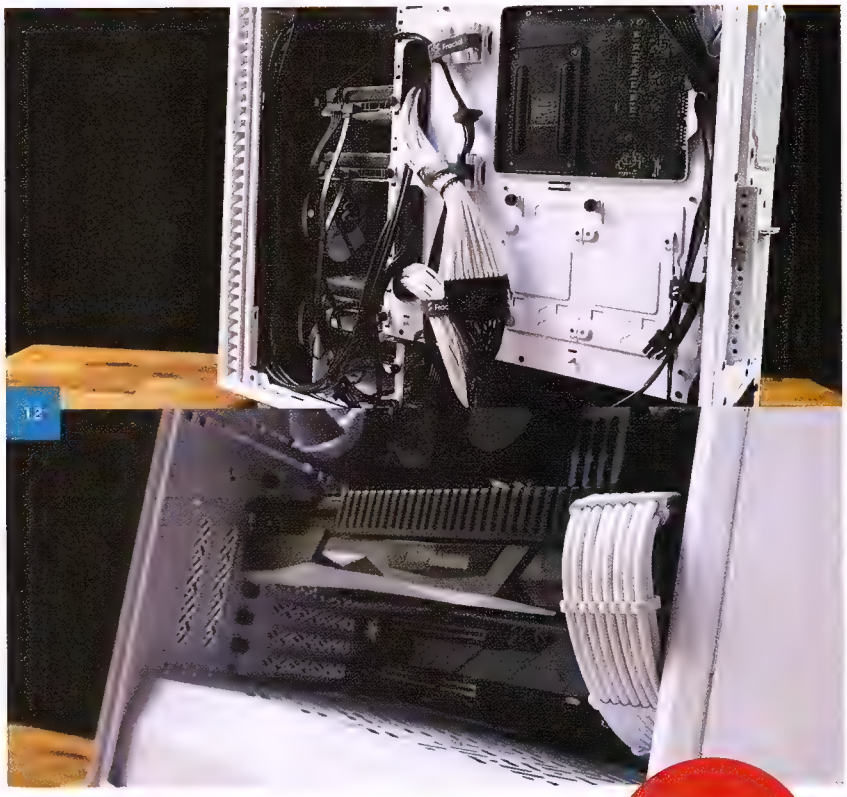


the stock AM4 motherboard mounting. You may find other brands use their own cooler mounting. If so, I would install that mounting on the motherboard outside of the case first. No additional thermal paste is required here as Fractal Design has already pre-applied it to the base of the CPU cooler. 10

Next, I can mount the GPU and power supply. Something to be aware of is the length of the graphics card. Some cases might have issues with longer cards. The Zotac RTX 2080 Super AMP Extreme is an absolute beast and was actually fouling on one of the hard drives. This wasn't much of an issue for me as I could relocate this drive to another drive bay under the PSU shroud. 11

To finish, it's time to cable the system up. Don't worry about getting everything perfect around the back, a few zip ties to hold the cables down is all you need. I prefer to spend more time on the main side and with some CableMod sleeve extensions, the system is looking really sharp. 12

After powering on the system, we can see just how well all the components come together. The RGB from the Fractal Design cooler, G.Skill memory and the Zotac 2080 Super complement each other nicely – nothing over the top. But if RGB isn't your thing, all can be controlled and changed to a single static colour if preferred. ■



Keeping things tidy is a forte of Stuart's builds, and this PC is slick and clean.

WIN IT!

Worth $6,600

You could win this stunningly built and immensely powerful PC! Western Digital generously approached *APC* at the outset of this project asking if we wanted to be involved, and to run a competition to give it away to one of our readers. That could be you!

The PC is valued at over $6,600, and that's for the parts alone which is not taking into account Stuart's time and talents in creating a PC that is beautiful and unique.

To enter, head to *TechRadar*, the home of *APC* online, and enter at **www.techradar.com/news/apcmag**

Closing date for entries is Sunday August 9th at 11:59pm. The winner will be chosen on Monday August 10th 2020 and notified by email and phone (if a phone number was provided on the entry form). Full terms and conditions at the URL above.

SUPERGUIDE

PROTECT YOUR DATA

Encrypt files, folders, and even entire drives to keep your information secure.

Worried about the security and visibility of your data? Do you have sensitive files you want to keep away from potentially prying eyes? Worried that your cloud backup isn't as secure as it might be? Concerned that the data on your laptop might be vulnerable to theft? Want to dispose of files – or an entire PC – without compromising the data (including previously deleted files) on it? You've come to the right place.

In this feature, we explore numerous options for protecting your data, both data stored on your PC and that backed up elsewhere, whether on local storage or in the cloud. We also reveal how to ensure all data you delete is shredded beyond recovery, too, enabling you to pass on a PC or drive to a new home without having to worry about the data previously stored on it.

When it comes to sensitive files, the solution lies in a process called encryption. File encryption works using cryptography to scramble the contents of files so they're unreadable without the correct authentication – usually a password that is used to unlock an encryption key, which in turn decrypts the file so it's readable. Some encryption can be further strengthened by the requirement of additional forms of authentication such as so-called key files or physical devices, like smart cards.

Encryption keys are created using special algorithms. Common examples include Advanced Encryption Standard (AES) and Twofish. The higher the bitrate, the more secure the key, so 256-bit is better than 128-bit, and 512-bit is better than 256-bit. Encryption is a resource-heavy process, particularly as bitrates increase, so be prepared to see protected files take longer to open or save. If you have a modern CPU, you'll find AES is by far the quickest encryption standard, thanks to the implementation of hardware-accelerated AES encryption on supported processors.

Encryption can be performed on individual files or entire drives, and that's where we begin our feature, with a comprehensive guide to scrambling the files on your PC. Turn the page to get started.

When it comes to encrypting individual files or entire drives, there are numerous options available. If you're running the Pro, Enterprise, or Education version of Windows 10, you'll find built-in options exist in the form of BitLocker and EFS – the box opposite reveals how BitLocker works and what you need to run it. EFS – Encrypting File System – enables you to individually encrypt files or folders using your Windows password as the encryption key. If the drive is stolen, the files are unreadable without your Windows account password.

To encrypt one or more files or folders, select them in File Explorer, right-click the selection, and choose Properties. Click Advanced, then tick the box next to Encrypt contents to secure data. Click OK then Apply – you're prompted to encrypt the parent folder if applicable for greater security. Make your choice, then click OK.

EFS is a simple but relatively weak way to encrypt files. If you're looking for something stronger, or don't trust Microsoft with keeping your data secure, read on.

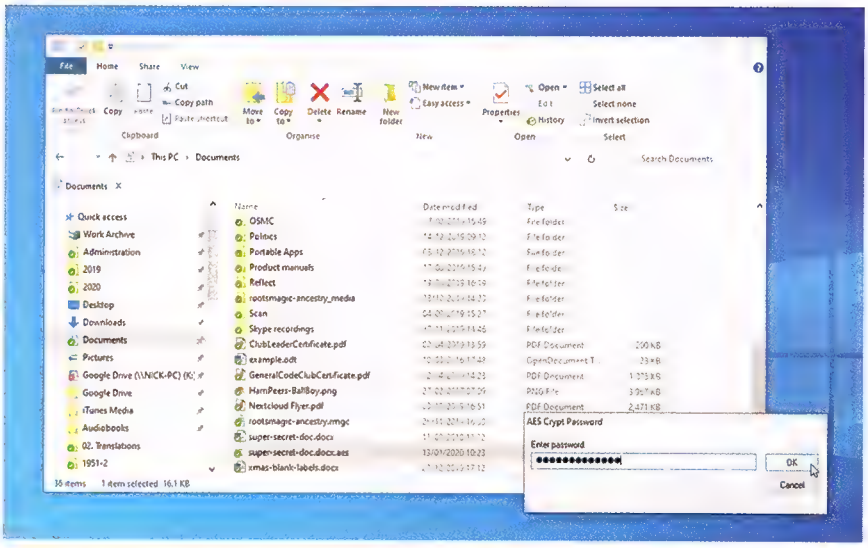
Simple, fast file encryption

If you only need to encrypt individual files on a semi-regular basis – or wish to encrypt files before sharing them with others – the open-source tool AES Crypt (**www.aescrypt.com**) is all you need. Download and install the program, then going forward, simply right-click the file you wish to protect, and choose AES Encrypt. Enter a strong password – the more characters, the stronger the encryption – and click OK. An encrypted copy of the file with an .aes file extension is created, unreadable to anyone who doesn't know the password.

If you want to share the file with others, send them the encrypted version, then communicate the password separately and securely. They need to install AES Crypt before double-clicking the file and entering the password required to extract the decrypted original.

It's also possible to encrypt Office documents – but encryption is only effective in Word 2007 or later when first AES 128-bit, and more recently (from Office 2016) AES 256-bit, encryption is employed. To do so in Office 2007 or later, select the File tab and choose Info > Protect Document > Encrypt with Password.

If you want stronger encryption for individual files or folders, Gpg4win (**www.gpg4win.org**) works in a similar fashion to AES Crypt, with the added bonus of allowing you to encrypt files using public keys protected by passphrases for additional security. After installation, launch the Kleopatra tool and choose File > New Key Pair, then select Create a personal OpenPGP key pair to get started. Once done, you can then encrypt files by right-clicking them in File Explorer and choosing Sign and encrypt to use your key (you can also encrypt files with a simple password, too, if you prefer).



AES Crypt won't delete your original file after creating an encrypted copy.

A one-stop solution

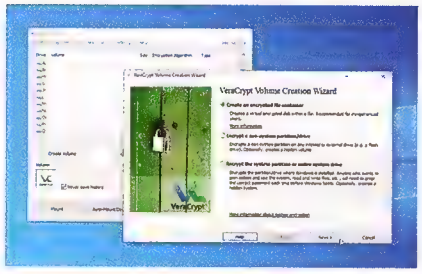
AES Crypt and Gpg4win are perfect for occasional encryption, but you'll need to re-encrypt your files each time you make changes to them. If you want a more comprehensive, flexible solution, VeraCrypt (**www.veracrypt.fr/en/**) pretty much does it all. It can be used in a variety of ways to meet most people's needs – like BitLocker, you can encrypt entire drives, including your Windows boot drive, but you can also restrict its use to a specific set of sensitive files using a smaller virtual encrypted container, which resides as a file on your hard drive.

The app is available for Windows, Mac, and Linux, so you can use it across all your computers. There's a portable version available, too, which can do everything except encrypt your boot drive. After downloading and installing (or extracting to your portable apps folder), launch the program – Veracrypt-x64.exe if you're running the portable version – and you will find yourself at the main VeraCrypt window.

Create a virtual drive

The VeraCrypt Volume Creation Wizard now opens, with Create an encrypted file container selected by default. This is the safest option, because it merely creates a single file on an existing hard drive, inside which all your sensitive data will be stored for you. There's no risk to any other files or drives. To proceed, click Next.

Two types of volume can be created – to simply protect the data if the drive it's on is lost or stolen, leave Standard TrueCrypt volume selected, and click Next again.



VeraCrypt's wizard makes it easy to create any kind of encrypted drive.

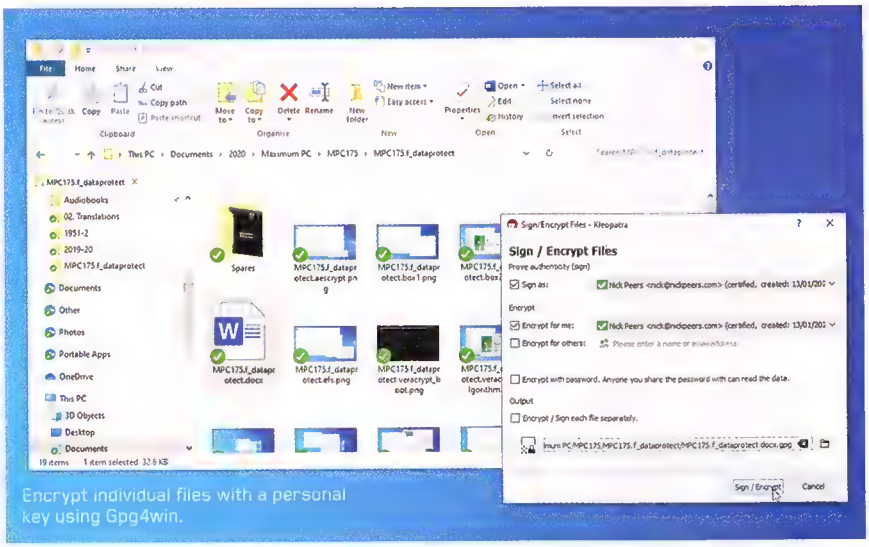
Skip to the next section. You'll also see an option to create a hidden volume, with an explanation about why you might want one. Hidden volumes are created inside standard TrueCrypt volumes, hiding themselves in their free space.

First-time users should select Hidden TrueCrypt volume then Normal mode to create a standard TrueCrypt volume inside which your hidden volume will be created. If you've already created a standard volume, you can choose Direct mode instead when prompted, and follow the prompts to set it up inside your standard TrueCrypt volume. In either event, the wizard follows a similar process to that for standard volumes, as described below.

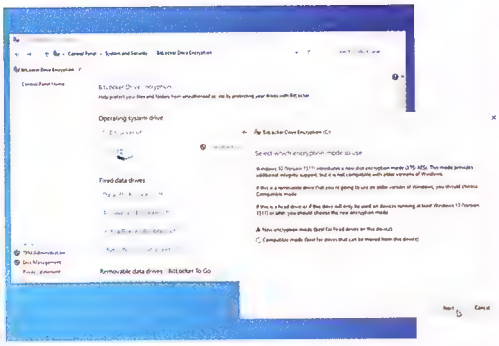
One tip if you plan to create a hidden volume: Be sure to save selected files to the standard volume. An empty standard volume would arouse suspicion among those you're trying to hide your data from.

Set up a standard volume

Click the Select File… button, browse to your USB thumb drive, then type a new file name into the File name box. Avoid using a file extension – this can be problematic – and click Save. Click Next to choose your encryption options for the volume. Five encryption algorithms are supported: AES, Serpent, Twofish, Camellia, and Kuznyechik – select one at



Encrypt individual files with a personal key using Gpg4win.



BitLocker Drive Encryption

If you're using a higher-end version of Windows – Professional, Education, or Enterprise – and you're looking to encrypt an entire drive, you might like to use the built-in BitLocker tool. It can be used to encrypt fixed and removable drives, as well as your Windows boot drive, making it possible to protect the contents of your laptop should it be stolen.

Type "bitlocker" into the Search box and click Manage BitLocker. You'll see a list of all available drives in the main window. Expand one and click Turn BitLocker on. If you're looking to encrypt the main system drive, you may see an error about your PC not having a compatible Trusted Protection Module. Check your motherboard specifications – you may be lucky and simply need to enable TPM support in the BIOS (look in the Security section).

You're prompted to create a backup of the recovery key required, then follow the wizard, selecting appropriate choices depending on your drive and PC setup. Run the recommended BitLocker system check, and you should be able to use your drive while it's being encrypted.

Fixed or removable data drives are protected by password or a compatible smart card – TPM module not required. When you plug in the drive or reboot Windows, you need to provide the password or plug in the smart card to unlock the drive.

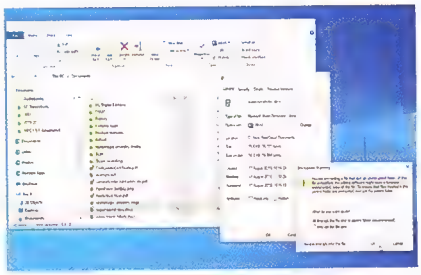
BitLocker is relatively straightforward to use, but relies on your trusting Microsoft, because unlike the open-source VeraCrypt, its code isn't available for audit. You're also restricted to its 128-bit or 256-bit AES encryption.

> "An encrypted file container is the safest option, because it creates a single file on an existing hard drive"

a time for a description. Beneath these are no fewer than ten combinations of two or more algorithms for those who want multiple layers of encryption. The truly paranoid can click the Test button next to an option to verify VeraCrypt's implementation of the selected algorithm is compliant with certain standards.

Click the Benchmark button to open the Algorithms Benchmark window, then click Benchmark to compare the performance of each encryption algorithm. The process of encrypting and decrypting data will have an impact on disk write/read speeds, and you can compare the different algorithms (single and combined) from here. Straight AES encryption is recommended for most people, or AES combined with Twofish if you want a second layer.

Beneath the encryption algorithm, you'll see a section on hash algorithms, complete with a handy link explaining how they work. These are basically used to generate the encryption keys and salt (random data used to protect your password from hackers). Five hash algorithms are currently supported, but for most people, the default SHA-512 is fine – you might choose SHA-256 if performance is more important than security.


Windows 10 Home users don't get access to native encryption tools.

Extra authentication

Once you've chosen your options, click Next. You're now prompted to set a size for your file container. Choose a figure based on how much data you need to encrypt and how much free space is available. Click Next to enter a password – you'll need this to access your files in future, so make sure it's memorable (or stored somewhere secure, like a self-hosted Bitwarden password manager), but also tough to crack. Try to make it at least 20 characters in length.

Gain additional protection by ticking Use keyfiles and clicking the Keyfiles button. This adds another layer of protection: Not only do you have to enter your password correctly, but you also need to select whichever file (or files) you choose to be linked to your container. These files can be already present on your hard drive – choose a compressed format such as MP3 or Zip – or you can have VeraCrypt generate a new random key file from scratch. Either way, make sure the files are backed up somewhere safe, because if they're deleted or the first 1,024KB of data is changed, your vault will be impossible to access.

Checking the Use PIM box creates an additional step after clicking Next, where you can set a custom Personal Iterations Multiplier. The default setting (485) prioritises security over speed when mounting the volume after each system

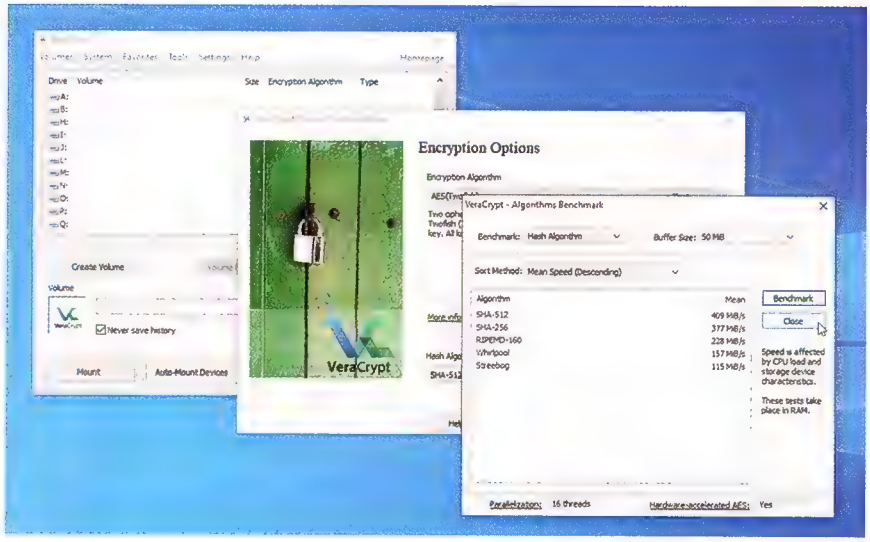
Encrypt in place

It's possible to encrypt an existing data drive without wiping it in VeraCrypt using Encrypt in place. But there are drawbacks. Unlike encrypting your Windows installation, the drive won't be available while it's being encrypted. Also, when done, you're prompted to assign it a different drive letter – this isn't necessary as we'll explain shortly.

Choose Encrypt in place, click Next, read the warning, and click Yes. You're prompted to set encryption and authentication options, then asked to move your mouse randomly to strengthen the encryption keys, before ending up at the 'Wipe Screen'. This allows you to shred unencrypted files after the drive has been encrypted to prevent them from being recovered by undelete tools later. Only the most paranoid should consider anything other than None (fastest) or 1-pass (random data).

Click Next, then Encrypt. Click Yes (you may need to click Yes again if the drive is in use, to dismount it), then wait for the drive to be encrypted. Once done, read any warnings, and click Finish. To keep the same drive letter, right-click This PC in File Explorer, and choose Manage. Identify your encrypted partition using its drive letter, right-click it, choose Change Drive Letter and Paths, select the current drive letter, and click Remove, then OK. You should now be able to select the drive letter in the main VeraCrypt window, and click Auto-Mount Devices to follow the advice in the main feature to access the drive. If you wish to decrypt the drive permanently, select it, and choose Volumes > Permanently Decrypt.

Key files add an additional layer of security to your encrypted data drives.



VeraCrypt's benchmark tool shows you how each algorithm or hash performs.

> "This form of encryption is particularly suitable for those who carry sensitive information with them on a laptop."

boot – should you wish to reduce the time taken, you can set a lower value, but make sure you've set a lengthy password.

Format and mount

After clicking Next, you're asked if you plan to store files larger than 4GB in your new virtual drive – this determines which filesystem is set as the default in the next step (exFAT if yes, FAT if no). Click Next and you're ready to configure and format your volume. You can change the filesystem here – NTFS and ReFS are also available – plus choose whether to perform a quick format (not recommended). Checking Dynamic means the file containing your encrypted volume isn't formatted as its actual size, but instead increases in size as you add content to it – this comes with several warnings, not least of which are severely degraded performance and reduced security.

You'll see a prompt to move your mouse within the VeraCrypt window to improve the cryptographic strength of the volume's encryption keys. When you've configured the drive and the Randomness Collected From Mouse Movements meter is full, click Format, and the encrypted volume is created. Wait until the confirmation dialog box appears, then click OK followed by Exit to return to the main VeraCrypt window, ready to access your encrypted container for the first time.

Select a free drive letter from the list and click the Select File button to choose your encrypted container. Click the Mount button and then enter the volume's password before – if applicable – clicking the Keyfiles... button to select the required files that will give you access to your container when you click OK.

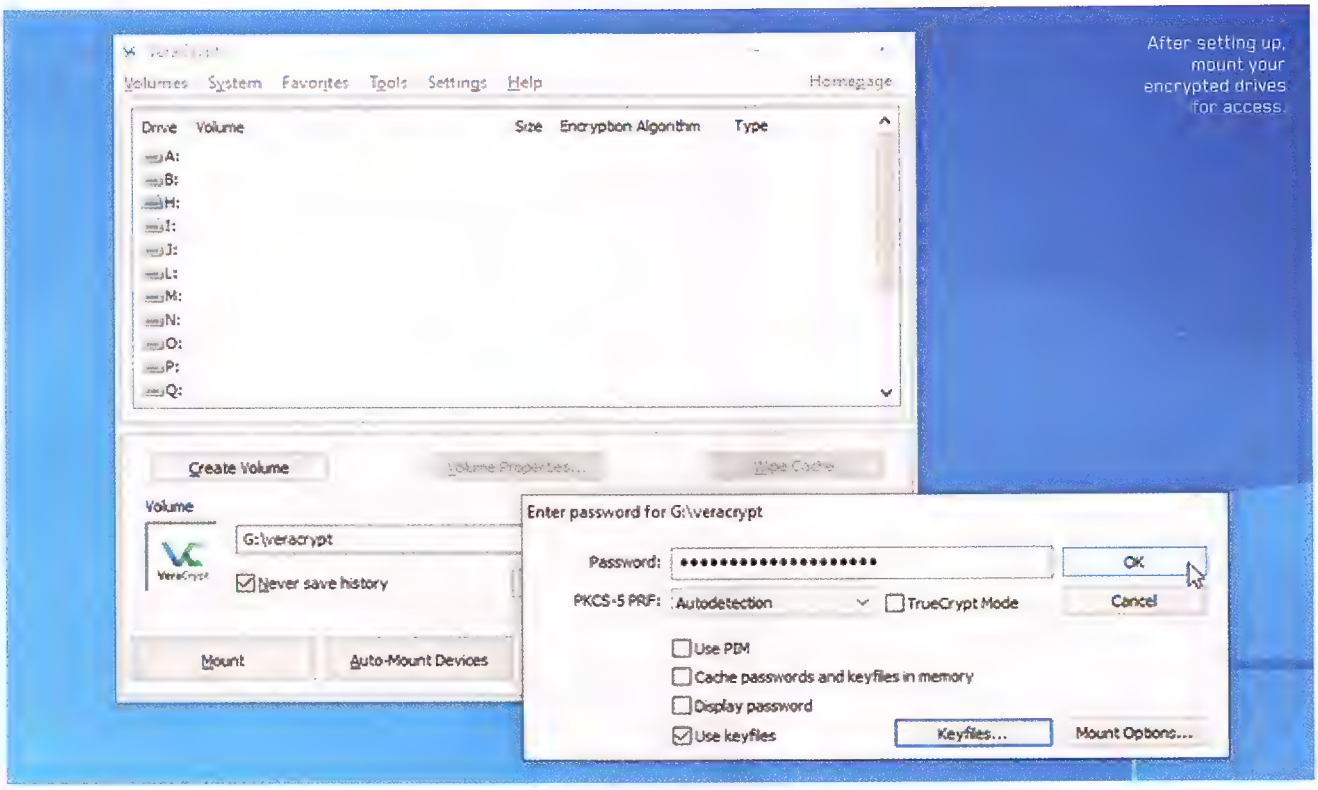
You'll see a Mount Options... button; clicking this reveals options such as opening the volume in read-only fashion, or assigning it a specific drive label in Windows. If your volume contains a further hidden volume, be sure to tick Protect hidden volume against damage caused by writing to outer volume to safeguard its contents.

After clicking OK, wait while the volume is mounted – you should see your encrypted container appear in the main VeraCrypt window. It can now be accessed like any other drive – copy or save files directly into here to ensure they're protected going forward. When you've finished with the drive, right-click its entry in the VeraCrypt window, and choose Dismount to lock it away from prying eyes.

Encrypt Windows

VeraCrypt can also be used to encrypt your entire Windows installation. All files remain encrypted on your disk even in use – they're simply decrypted on demand to allow Windows and your apps to run normally without exposing the data to potential problems, such as sudden power loss.

This form of encryption is particularly suitable for those who carry sensitive information with them – typically on a laptop. Take a drive image backup before you begin, then launch VeraCrypt and



choose Create Volume > Encrypt the system partition or entire system drive. Again, standard and hidden options are available (click More information if you like the idea of hiding your OS from view – it's a long, detailed subject, and involves creating a 'decoy' OS).

Assuming you simply want to encrypt the drive, leave Normal selected and click Next. You can opt to simply encrypt the Windows partition, or the entire drive (so all partitions on the primary hard drive). If in doubt, encrypt the system partition only – you may get a warning when attempting to encrypt the entire drive about losing access if it has a so-called 'inappropriately designed' BIOS.

The next step informs VeraCrypt whether you have a single-boot or multiboot system, and then it's a similar process as for creating an encrypted virtual drive.

There's just one caveat: you can only protect your system drive with a strong password; key files aren't supported. You also need to create rescue media – don't skip this step, because it's required to both permanently decrypt your drive and provide protection against corruption.

Different media is required depending on whether your boot mode is EFI (USB flash drive) or MBR (CD/DVD) – just follow the prompts to create and verify the media. The recovery media is tied to your specific PC and the current password you've assigned to your boot drive. If you make any hardware changes, you need to recreate it.

You next see the Wipe Mode screen, which enables you to securely overwrite the unencrypted copies of your files after they've been encrypted – the more passes, the slower the process, so unless you have reason to be truly paranoid, none or just '1-pass' should be sufficient.

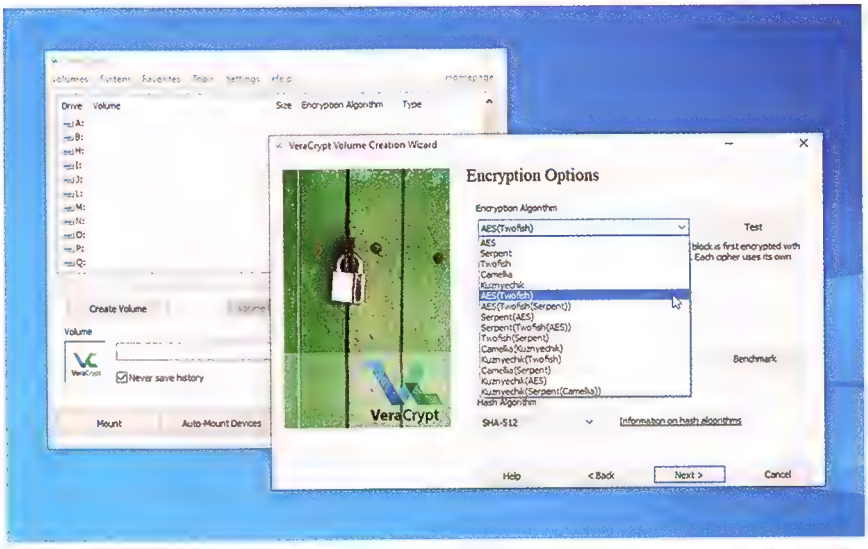
Test and encrypt

You're now ready for the drive to be encrypted – first, a pretest is run to verify everything works as it should do. Your PC reboots, and you're prompted to enter the password you just set up. When prompted for the PIM, just press Enter unless you manually specified this value. Wait for the password to be verified – then Windows boots as normal.

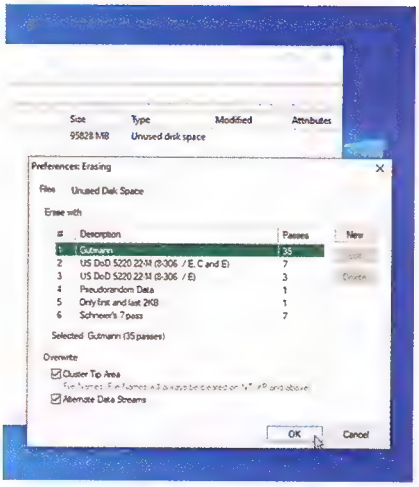
If the test passes, click the Encrypt button and VeraCrypt starts to encrypt your drive's contents (a Defer button is also present if you wish to back up data first – you're then prompted again the next time Windows is restarted). Unlike with encrypting non-system volumes, you can carry on using your PC while the drive is encrypted. Once complete, your computer's contents are protected against theft and other threats, ensuring any data stored on the drive is secure.

Encrypt entire drives

VeraCrypt can also be used to encrypt other drives and partitions, from internal data drives to USB thumb drives. As with all major operations, we strongly



You need to balance security versus performance when picking an algorithm.



Shred data securely

When you delete a file, it's not physically removed from your PC; instead, the first few bytes of the file are overwritten with a tag that tells Windows that the file is deleted and the space it currently resides in is available when writing other files to disk. It speeds things up, but it's not good for security.

Until the file is physically overwritten by another file, its contents are still retrievable. What's more, even if the file is overwritten, it might be possible to retrieve part or all of it using sophisticated file recovery techniques. So, how do you protect yourself against that kind of technology?

Thankfully, there are tools that can securely wipe data from your drive. One that's free and open source is Eraser (grab the latest stable version, 5.8.8, from **https://eraser.heidi.ie/download**). During installation, enable the Windows Explorer extension to allow you to securely shred any file by right-clicking it and choosing Eraser > Erase. What about files you've previously deleted? Eraser can securely wipe all free space to make deleted files unrecoverable – right-click the drive in File Explorer, and click Erase > Erasing Free Space.

Open the main Eraser program and you can set up on-demand and scheduled tasks to periodically shred specific files, folders, or free space. By default, Eraser wipes data using the Gutmann technique – if this is too slow, choose Edit > Preferences > Erasing to choose a different method, including one of two used by the US Department of Defense.

recommend you first take a full image of your hard drive before starting the process – just in case. Once the drive is safely encrypted, you can safely delete this backup. However, if you plan to keep the backup, check out the box on thye following page about encrypting your backups.

The creation process is similar to setting up virtual drives. Start by selecting Encrypt a non-system partition/drive on the first page of the wizard. Choose whether the volume will be a standard one or hidden, then click Next. Click Select Device... to choose your target drive or partition.

The next step is crucial – you have a choice between Create encrypted volume and format it (destructive, and best for empty drives or drives with no data worth keeping) and Encrypt partition in place. The latter is much slower but preserves existing data. If creating an encrypted volume from scratch, the process is virtually identical to creating virtual drives.

Once the drive has been encrypted, read any warning messages, then click Finish. To mount the drive, select the drive letter you wish to assign to it, then click Auto-mount Devices. Enter the credentials required, wait, and then the drive is mounted and available.

Ordinarily, you have to do this every time you restart Windows – to have the drive automatically mount when you log into Windows, right-click it in the main VeraCrypt window after mounting, and choose Add to Favorites. Be sure to check Mount selected volume upon logon before clicking OK. In the future, you will be prompted to provide the password and any key files each time you log into Windows, and then the drive will be available.

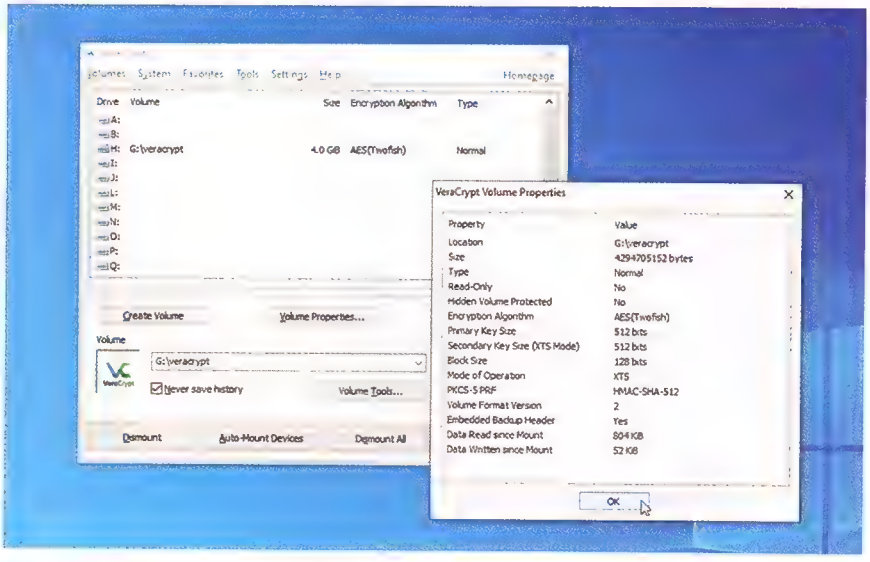
One problem with this approach occurs if you've moved system folders – such as user folders or those linked to cloud services – on to this encrypted storage space. You get errors about missing folders before you unlock the drive. If you've encrypted your Windows boot drive, you can get around this by ensuring the password on your data drive is the same as that required to unlock your Windows boot drive, then choose Add to System Favorites – this way, the drive is unlocked with your boot drive, and available when Windows loads.

Encrypt cloud backups

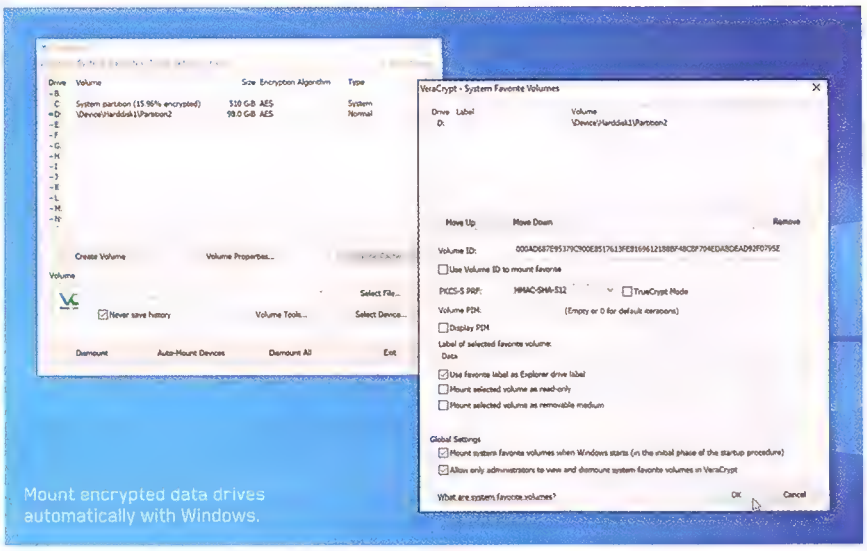
VeraCrypt can protect your files locally, but copy them anywhere else, and they're left unprotected. The box opposite reveals what to do about protecting local backups using the same types of algorithms with suitable backup software, but what about those files you back up to the cloud? Cloud providers claim to encrypt your files, but sometimes that only applies to the way the files are transferred – when stored 'at rest' in the cloud, they may be left unencrypted, and therefore potentially vulnerable.

Even where encryption is provided, is it true end-to-end encryption, where only you possess the all-important encryption keys required to decrypt the files? Some cloud providers – SpiderOak (**https://spideroak.com**) and Tresorit (**https://tresorit.com**), for example – adopt this 'no knowledge' policy, but others don't.

You don't need to switch cloud provider to get this kind of protection; instead, add your own layer of encryption to critical files, with keys not shared with anyone else. An open-source encryption tool designed for cloud-based storage is Cryptomator (**https://cryptomator.org**), which works with any cloud provider from OneDrive to Dropbox. The principle is identical to VeraCrypt: You create a password-protected virtual drive – or



Select "Volume Properties..." to verify the security of your drive.



vault – inside which your sensitive files are stored. The key difference is that Cryptomator encrypts files and folders individually, rather than as part of a larger file, so changes are smaller and quicker to upload and download.

Create a container

To start, go to **www.cryptomator.org/downloads** and click Download 64 Bit. Once saved to your hard drive, double-click the setup file, and follow the install prompts, making sure you install the Dokan File System Driver when asked. Reboot if prompted.

Open Cryptomator via the Search box or Start menu, then enable the integrated update check when prompted to ensure Cryptomator stays up to date. Click the '+' button and choose Create New Vault. Navigate to your cloud folder, give your vault a suitable name (this will be the name of the folder containing your encrypted files on the drive, so don't make it too obvious), and click Save.

You're prompted to create a password to protect the vault and access it from other computers or mobile devices. We recommend generating a long random one using your password manager (store the password as a secure note). Once entered and safely recorded, click Create Vault.

Click More Options to save the password and automatically mount the drive at startup (only recommended on a secure PC). You can also change the drive name and choose a drive letter. Then enter your password and click Unlock Vault.

A new Explorer window eventually opens, pointing to your new virtual drive (it's also accessible via This PC under Network locations) – simply copy or save files in here, and they're encrypted securely before being uploaded to the cloud.

When done, you can leave the drive unlocked until you shut down your PC or – if security is an issue – open the main window and click Lock Vault to close it down (enter your password and click Unlock Vault to bring it back later if you need to).

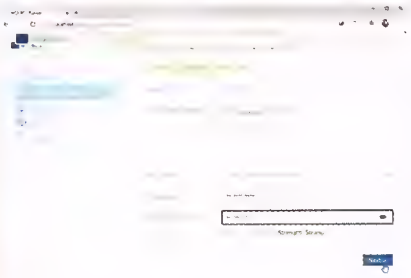
You can access your cloud-hosted vault from other computers by installing Cryptomator on there and choosing Open existing vault. There are even paid-for apps for Android or Apple phones if you need to upload sensitive files while on the road.

Shortcomings

Our main gripe with Cryptomator is that its presence can't be hidden – and, in fact, is blindingly obvious to any hacker combing through your folders. That's because its master key is visible inside the folder containing your encrypted data (even the name – masterkey.cryptomator – isn't subtle). This highlights the need to keep an independent backup of any data stored in a Cryptomator vault in case these key files are damaged or lost.

If that's a deal-breaker, consider switching back to VeraCrypt, but minimise the size of your vault (make multiple smaller vaults, rather than one large one). This helps reduce the amount of bandwidth used when uploading and downloading changes to encrypted files. Another approach is to use cloud storage for encrypted file and image-based backups (see box right). ■

Strengthen your Cryptomator vault by using a randomly generated password.



Encrypt backups in the cloud

You've encrypted the files on your hard drive, but what about your backups? By default, backup tools store your files unencrypted on a local or network drive, which is fine if the drives have been encrypted with VeraCrypt or BitLocker, but what if you just want the backups to be encrypted; perhaps you'd like to store them securely in the cloud?

The answer lies with the free and open-source backup tool Duplicati, currently in beta (**www.duplicati.com**). This has been engineered like Cryptomator for the cloud, but specialises in file-based backups. After downloading and installing, let Duplicati launch – configuration is done through a browser window. Click Add backup to work your way through the backup wizard. You're prompted to set your encryption level (the default AES-256 is more than adequate) and passphrase at the start.

Next, select your destination. You can back up locally or directly to a range of cloud providers – Google Drive, OneDrive (choose the v2 option), Dropbox, and so on). If yours isn't listed, choose your cloud provider's local folder, and let its native app sync the backup files after it's been taken.

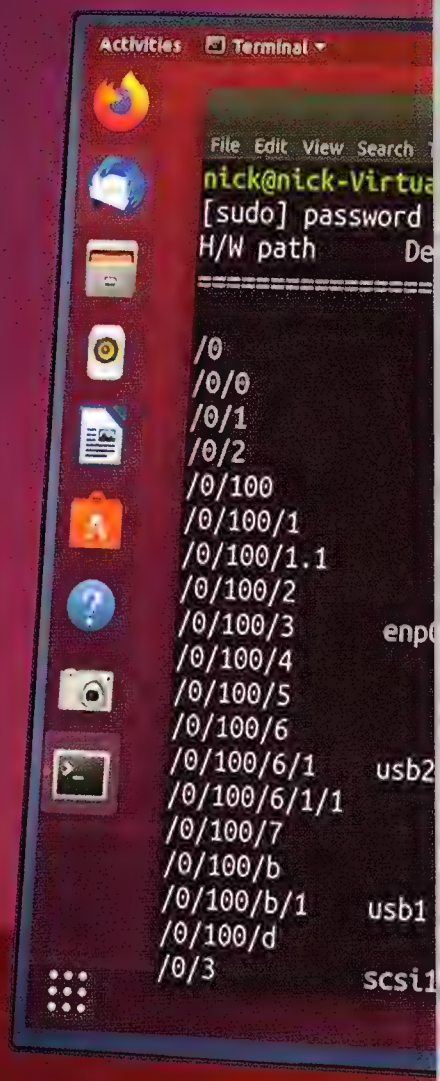
From here, select which files and folders to upload, set a schedule for updating the backup, and choose how many backups to retain. Click Save, then opt to run the backup now. A progress meter shows how far it's got – look at the throttle button if the uploading impacts your Internet performance.

When it comes to recovering files, select Restore, and follow the wizard – you can recover individual files as well as older versions of a file.

FEATURE

Linux Command-Line Tips & Tricks

Take your knowledge of the Linux Bash shell beyond the basics with Nick Peers.



There's no excuse not to school yourself in the ways of Linux command-line operations. Whether you're accessing the Terminal on your Linux desktop, logged directly into the Bash shell, or intrigued by Windows 10's support for CLI-based Linux distros, you've come to the right place. We're going to assume you know the basics of Linux's Bash shell and command language. As a quick reminder, Bash uses a relatively straightforward syntax for each command:

$ utility command -option

The `utility` portion of the command is the tool you wish to run, such as `ls` for listing the contents of a directory, or `apt-get` for triggering the package management tool.

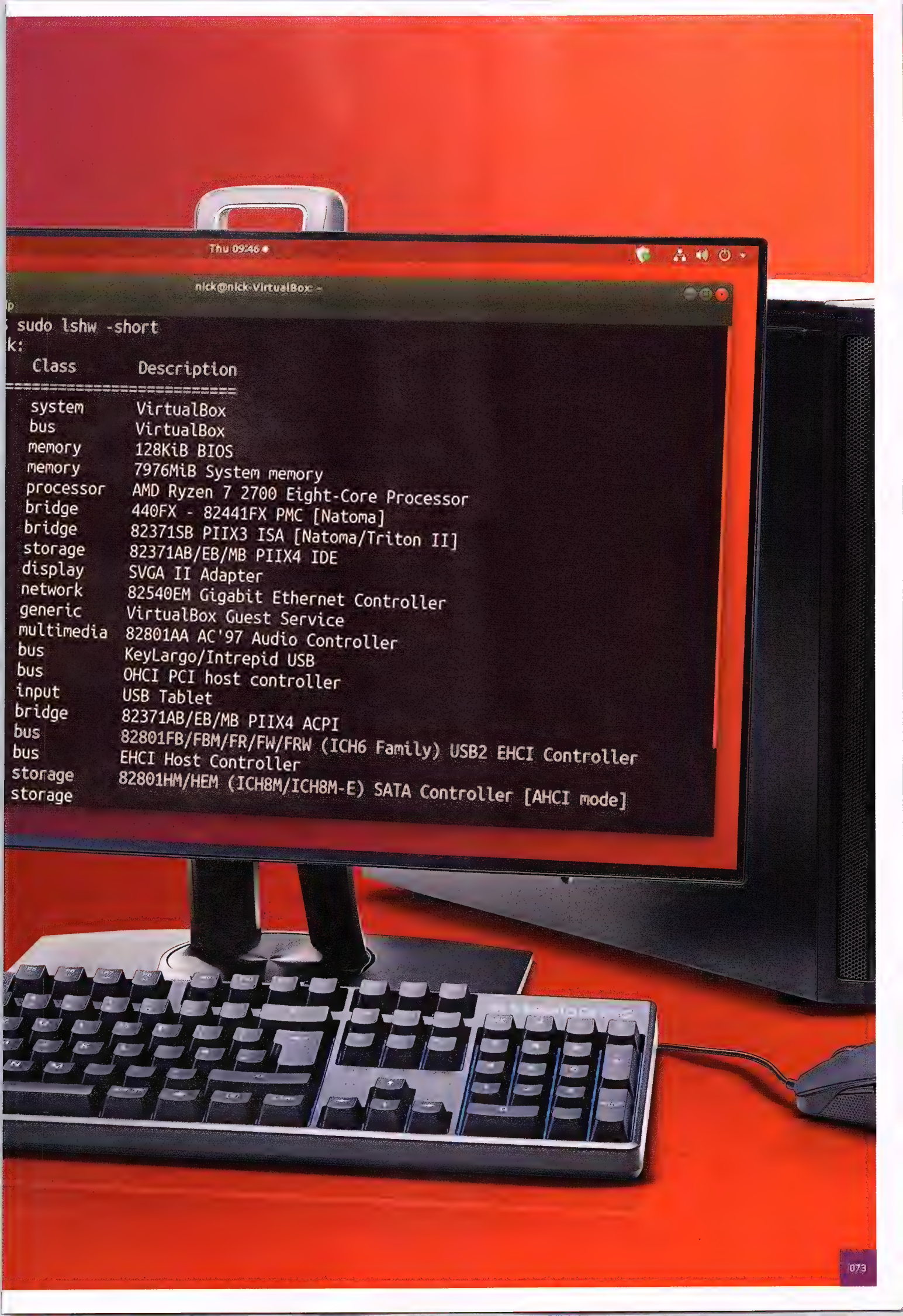
The `command` section is where you specify exactly what you want the utility to do. Typing `apt-get install` instructs the package management utility to install the named package, such as:

```
$ apt-get install vlc
```

The `-option` section is where one or more "flags" can be set to specify preferences. Each flag is preceded by one or two dashes, and the most useful is the `--help` option, which gives a description of the utility, plus available commands and options. Utilities can be run on their own, with a single command or flag, or as a combination of the two.

With this basic framework in place, you're ready to start exploring how you can interact with Linux via the command line – for Windows users, this introduces the intriguing possibility of being able to run Linux CLI apps and services on your PC without installing a virtual machine or dual-boot setup.

In this feature, we're going to look at some more advanced uses of the Bash shell, from the practical (work with permissions and interrogating your hardware) to the more whimsical – surf the net directly from the shell, plus play music, and have some fun with ASCII art into the bargain. In between, you'll learn various tips and tricks to speed things up. Enough chit-chat, it's time to paddle into the slightly deeper waters of more advanced Terminal usage. Don't worry, the water's still warm.


Thu 09:46
nick@nick-VirtualBox: ~
sudo lshw -short
k:
Class Description
system VirtualBox
bus VirtualBox
memory 128KiB BIOS
memory 7976MiB System memory
processor AMD Ryzen 7 2700 Eight-Core Processor
bridge 440FX - 82441FX PMC [Natoma]
bridge 82371SB PIIX3 ISA [Natoma/Triton II]
storage 82371AB/EB/MB PIIX4 IDE
display SVGA II Adapter
network 82540EM Gigabit Ethernet Controller
generic VirtualBox Guest Service
multimedia 82801AA AC'97 Audio Controller
bus KeyLargo/Intrepid USB
bus OHCI PCI host controller
input USB Tablet
bridge 82371AB/EB/MB PIIX4 ACPI
bus 82801FB/FBM/FR/FW/FRW (ICH6 Family) USB2 EHCI Controller
bus EHCI Host Controller
storage 82801HM/HEM (ICH8M/ICH8M-E) SATA Controller [AHCI mode]
storage

Let's open with something that Linux is hot on: file and folder permissions. There's a great primer if you need it at **https://help.ubuntu.com/community/FilePermissions**, where you'll get an overview of how file permissions are displayed and how they're applied to three levels: the file or folder's owner, a specific user group, and then everyone else.

You can see a folder or file's current permissions (and its owner) by typing `ls -l`. You'll see 10 characters representing the permissions: The first character denotes whether the item is a file (`-`) or folder (`d`), and the other nine can be split into three lots of `rwx`, with `r` denoting read access, `w` write access, and `x` execute access to the file for the owner, the file's group (so all users assigned to that group), and finally everyone else.

A file or folder's permission can be changed using `chmod`, which assigns numbers rather than letters to denote the levels of file access (navigate to the file or folder's parent directory first). Use `sudo` if you're not the file or folder's owner:

```
$ chmod 777 filename
```

Substitute `filename` with the name of the file or folder you wish to apply the attributes to. When it comes to setting folder permissions, you'll usually want to apply the same permissions to its contents – including subfolders. Here, the recursive option (`-R`) comes into play:

```
$ chmod -R 777 folder
```

The key element is the number, which refers to the permissions you're setting, one each for the file owner, file's group, and everyone else. These are typically one of: `4` (`r--`, read only), `5` (`r-x`, read and execute – for programs), `6` (`rw-`, read/write but no execute), and `7` (`rwx`, full access). So, assign `644` to a folder or file and you're giving the owner read and write access, but restricting all others to read-only access. Set `775` and you're giving the owner and group full access, while anyone else can read and execute the file only.

A related tool to `chmod` is `chown`, which is used to change the owner or group of a file or folder, like so:

```
$ sudo chown user file
$ sudo chown :group file
```

Again, the `-R` option can be used to change the owner of a folder and all its contents. Use `chown` with care – if you get your path wrong, you could inadvertently screw up your entire filesystem.

Get hardware info

The following tools, all prefixed with `ls`, are designed to reveal information about your computer's hardware. Note: They're of most use to those running Linux natively– many don't work or display much useful information from the Windows Linux subsystem. Let's start with the `lshw` utility:

```
$ sudo lshw -short
```

This provides a barebones summary of your hardware, while `sudo lshw` goes to the opposite extreme (issue `sudo lshw -html > sysinfo.html` to create a summary file you can open in a web browser).

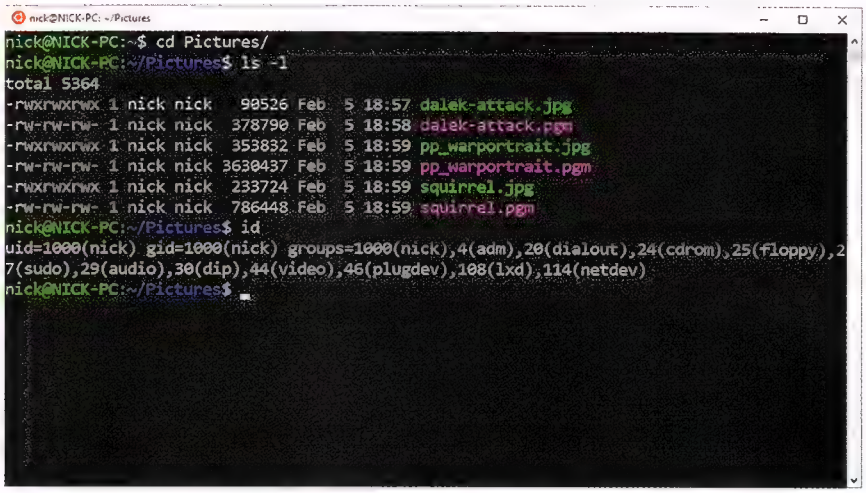
Other `ls` -based tools include `lscpu` (for detailed CPU information), `lsblk` (drive information), `lspci` (internal hardware), and `lsusb` (external peripherals). With the latter two, add the `-v` option to provide more detail, and invoke them using `sudo` to ensure you have full access to your system.

Another tool to consider is the `dmidecode` utility, which takes the information listed in your PC's BIOS, such as maximum supported memory and fastest CPU your motherboard can handle, and presents it in a more user-friendly format. It's best used in conjunction with the `-t` switch, which enables you to focus the tool on a specific part of your PC's hardware– for example:

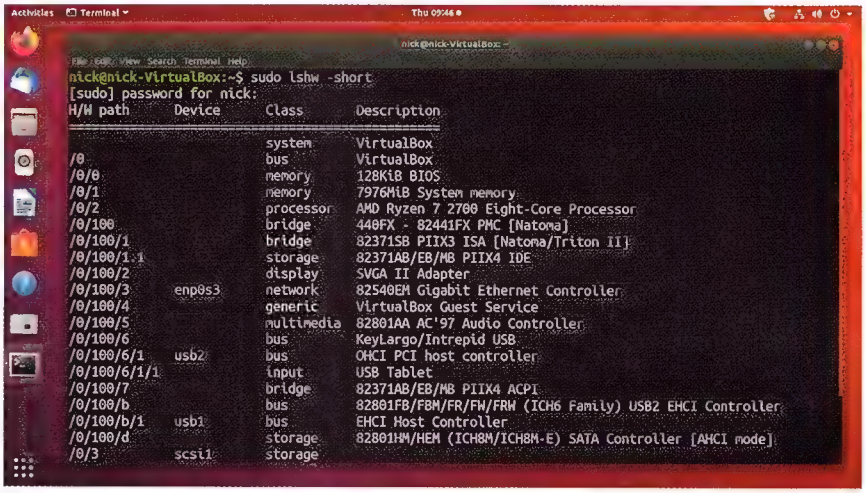
```
$ sudo dmidecode -t bios
```

The `bios` option reveals key information about your mobo, including what capabilities it supports (such as UEFI, USB legacy, and ACPI), plus the current BIOS version, including its release date. Other supported keywords include `baseboard` for identifying your motherboard make, model, and serial number, `processor` (check the "Upgrade" field to see what kind of socket it's plugged into), `memory`, and `chassis`.

One word of warning: The DMI tables that contains this BIOS-related information aren't always accurate, so


nick@NICK-PC: ~/Pictures
nick@NICK-PC:~$ cd Pictures/
nick@NICK-PC:~/Pictures$ ls -l
total 5364
-rwxrwxrwx 1 nick nick   90526 Feb 5 18:57 dalek-attack.jpg
-rw-rw-rw- 1 nick nick 378790 Feb 5 18:58 dalek-attack.pgm
-rwxrwxrwx 1 nick nick 353832 Feb 5 18:59 pp_warportrait.jpg
-rw-rw-rw- 1 nick nick 3630437 Feb 5 18:59 pp_warportrait.pgm
-rwxrwxrwx 1 nick nick 233724 Feb 5 18:59 squirrel.jpg
-rw-rw-rw- 1 nick nick 786448 Feb 5 18:59 squirrel.pgm
nick@NICK-PC:~/Pictures$ id
uid=1000(nick) gid=1000(nick) groups=1000(nick),4(adm),20(dialout),24(cdrom),25(floppy),27(sudo),29(audio),30(dip),44(video),46(plugdev),108(lxd),114(netdev)
nick@NICK-PC:~/Pictures$

Type `id` and press Enter to see what users and groups have been set up on your system.

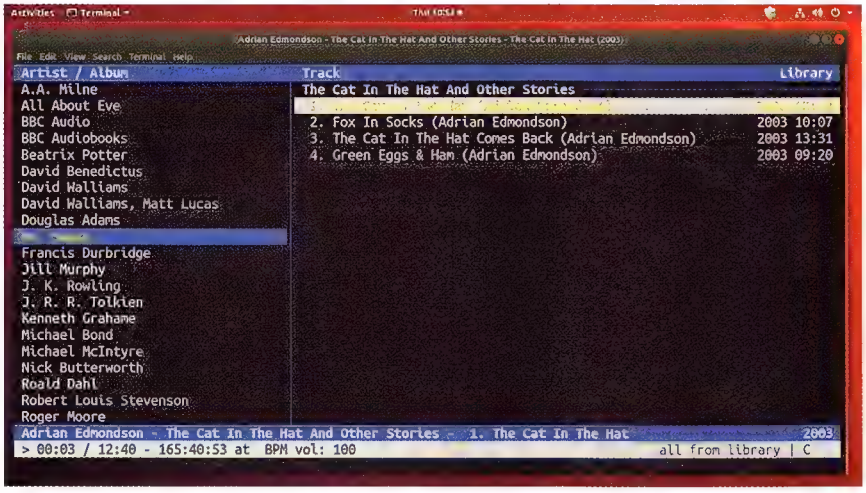

Activities
Terminal
Thu 09:46
nick@nick-VirtualBox: ~
File Edit View Search Terminal Help
nick@nick-VirtualBox:~$ sudo lshw -short
[sudo] password for nick:
H/W path Device Class Description
system VirtualBox
/0 bus VirtualBox
/0/0 memory 128KiB BIOS
/0/1 memory 7976MiB System memory
/0/2 processor AMD Ryzen 7 2700 Eight-Core Processor
/0/100 bridge 440FX - 82441FX PMC [Natoma]
/0/100/1 bridge 82371SB PIIX3 ISA [Natoma/Triton II]
/0/100/1.1 storage 82371AB/EB/MB PIIX4 IDE
/0/100/2 display SVGA II Adapter
/0/100/3 enp0s3 network 82540EM Gigabit Ethernet Controller
/0/100/4 generic VirtualBox Guest Service
/0/100/5 multimedia 82801AA AC'97 Audio Controller
/0/100/6 bus KeyLargo/Intrepid USB
/0/100/6/1 usb2 bus OHCI PCI host controller
/0/100/6/1/1 input USB Tablet
/0/100/7 bridge 82371AB/EB/MB PIIX4 ACPI
/0/100/b bus 82801FB/FBM/FR/FW/FRW (ICH6 Family) USB2 EHCI Controller
/0/100/b/1 usb1 bus EHCI Host Controller
/0/100/d storage 82801HM/HEM (ICH8M/ICH8M-E) SATA Controller [AHCI mode]
/0/3 scsi1 storage

Use the `-short` flag to get a handy summary of your hardware from the command line.

"Another tool to consider is the dmidecode utility, which takes the information listed in your PC's BIOS, such as maximum supported memory and fastest CPU your motherboard can handle, and presents it in a more user-friendly format."

	OPERATOR				
Description	;	&&	||	|	&
Will second command execute if first command executed successfully?	✓	✓	✗	✓	✓
Will second command execute if first command failed?	✓	✗	✓	✓	✓
Will the second command only execute depending on the status of the first command?	✗	✓	✓	✗	✗
Will commands execute in parallel?	✗	✗	✗	✗	✓

Chain operators enable you to link multiple commands together – here's how they work.


Artist / Album
Track
Library
The Cat In The Hat And Other Stories
2. Fox In Socks (Adrian Edmondson) 2003 10:07
3. The Cat In The Hat Comes Back (Adrian Edmondson) 2003 13:31
4. Green Eggs & Ham (Adrian Edmondson) 2003 09:20
A.A. Milne
All About Eve
BBC Audio
BBC Audiobooks
Beatrix Potter
David Benedictus
David Walliams
David Walliams, Matt Lucas
Douglas Adams
Francis Durbridge
Jill Murphy
J. K. Rowling
J. R. R. Tolkien
Kenneth Grahame
Michael Bond
Michael McIntyre
Nick Butterworth
Roald Dahl
Robert Louis Stevenson
Roger Moore
Adrian Edmondson - The Cat In The Hat And Other Stories - 1. The Cat In The Hat 2003
> 00:03 / 12:40 - 165:40:53 at BPM vol: 100
all from library | C

Cmus is an interactive music and audio player designed for the Bash shell.

while `dmidecode` is a potentially useful resource, don't be surprised if certain things (like installed RAM) don't stack up.

Get driver information

Many hardware issues can be traced to drivers (or modules, in Linux parlance). Another tool for displaying these modules is `lsmod`, which displays a comprehensive list of all modules that are currently in use. The "Used by" column lists which hardware devices each module is linked to – multiple entries are common because some drivers come in multiple parts (your graphics card requires drivers for the kernel and X server, for example).

Armed with a combination of `lspci -v` and `lsmod`, you can identify which module is being used by a specific hardware device. Once you have the module name, type the following to learn more about it:

```
$ modinfo <module>
```

Replace `<module>` with the name listed under `lsmod` (or `kernel driver in use` if you're using `lspci`). This then displays information about the driver filename, its version, and license. Other useful fields include author and description, plus vermagic.

In most cases, these modules are provided by the kernel, so vermagic should match the kernel version. One likely exception to this rule is your graphics card drivers if you've installed proprietary ones.

If `modinfo` returns an "Error not found" message, it means the listed module is an alias – to find the correct module name, type `sudo modprobe --resolve-alias <module>`, and then use the result with `modinfo`, which should now work correctly.

Chain of Command

Phew, let's move on to something less "heavy": command chaining. This is where multiple Linux commands are combined into a single line. The obvious use for a chain is to run multiple commands one after the other, enabling you to leave a lengthy process to its own devices without having to intervene. For example, quickly check for updates and install them using the following chained command:

Fun and games

The command line doesn't have to be a dull place to visit. If you fancy indulging in a little fun, try these entertaining tools and tips.

First, fancy viewing any photograph or image in ASCII art? Type **`sudo apt-get install imagemagick aview`**, and then type the following to view it in ASCII-rendered glory:

```
$ asciiview Path/filename.png
```

If you receive an "invalid magic-not" error, you need to convert the file first, as follows:

```
$ convert filename.png filename.pgm
```

How about producing text-based banners? Use FIGlet (**`sudo apt-get install figlet`**), which can be as simple as:

```
$ figlet APC rocks!
```

FIGlet can also write banners using different styles – first, discover what options are supported with the **`showfigfonts`** command, then you can use one of them like so:

```
$ figlet -f smslant I love Linux!
```

Other flags worth noting include `-t`, which forces FIGlet to use the whole of the Terminal window's width (use `-w 70` to specify a particular column width instead), and `-p` or `-n`, which you can use when piping lots of text (say the contents of a text file) through FIGlet. Basically choose `-p` to put FIGlet into paragraph mode, where it eliminates line breaks within paragraphs.

Fancy watching a silent – but subtitled – ASCII rendition of Star Wars? It's available online and can be watched by typing in the following:

```
telnet towel.blinkenlights.nl
```

Finally, the Terminal's calendar command can be used to look at more than just basic calendars – for example, **`calendar -f /usr/share/calendar/calendar.computer -A 365`** lists some handy historical computing dates. Substitute `computer` with `lotr` (Lord of the Rings), `pagan`, `history`, and `music` for alternate calendars, or type `ls /usr/share/calendar/` to see a complete list of what's available.

Time-saving tips & tricks

It doesn't matter how fleet of hand your typing skills are, the command line can still be a time-consuming, frustrating experience. Thankfully, the Terminal comes equipped with lots of handy time-saving shortcuts.

Here's how to easily access previously used commands and view suggestions:

Up/down arrows	Browse command history.
`history`	View command history.
Ctrl-R	Search command history. Type letters to narrow down your search, with the most recent match displayed. Keep pressing Ctrl-R to view other matches.
Tab	View suggestions or auto-complete word or path if only one suggestion exists. Press ~ and Tab to autofill your username, @ and Tab to autofill your host name, and $ and Tab to autofill a variable.

The following keys help you navigate the Terminal itself more efficiently.

Home/End	Press these to jump to the beginning or end of the current line.
Ctrl-left/right cursor	Move quickly between arguments.
Ctrl-U	Clear the entire line to start again.
Ctrl-K	Delete everything from the cursor's position onward.
Ctrl-W	Delete the word before the cursor.

- Accidentally omitted `sudo` from your command? Just type `sudo !!` and hit Enter to repeat the last command with `sudo` applied to it.
- If you make a typo when entering a command, instead of retyping the entire command, just use the following syntax to correct the mistyped word (in the following example, `dpkg` was originally mistyped as `dkpg`): `^dkpg^dpkg`

```
nick@nick-VirtualBox:~$ history
    1  cd Downloads
    2  sudo apt-get install ./nordvpn-release_1.0.0_all.deb
    3  sudo dpkg --configure -a
    4  sudo apt-get install ./nordvpn-release_1.0.0_all.deb
    5  sudo apt-get update
    6  sudo apt-get install nordvpn
    7  sudo apt-get update
    8  sudo apt-get install network-manager-openvpn-gnome
    9  sudo apt-get upgrade
   10  sudo apt-get install network-manager-openvpn-gnome
   11  sudo apt-get install openvpn
   12  cd /etc/openvpn
   13  sudo wget https://downloads.nordcdn.com/configs/archives/servers/ovpn.zip
   14  sudo apt-get install unzip
   15  sudo unzip ovpn.zip
   16  sudo rm ovpn.zip
   17  sudo add-apt-repository ppa:mdoyen/homebank
   18  sudo apt-get update
   19  sudo apt-get install homebank
   20  sudo apt-get update
   21  sudo apt-get install curl
```

Take a trip back in time with the `history` command.

`$ sudo apt-get update && sudo apt-get upgrade`

The `&&` that separates the commands is an operator, and Linux provides you with a choice of operators, enabling you to control how each command in the chain behaves based on the previous command. Think of `&&` as an AND operator – the second command only occurs if the first is successful (another example, `ping -c1 192.168.0.3 && ssh user@192.168.0.3`, only attempts to SSH into a computer after it's been successfully pinged).

Other operators include the semi-colon (`;`), which applies the second command after the first, regardless of whether it succeeds, and the double pipe (`||`), which acts as an OR operator, so only performs the second command if the first one fails.

You can combine multiple commands via different combinations of operators. For example, placing `&&` and `||` together is like producing an IF... ELSE... statement:

`$ apt-get update && sudo apt-get upgrade || echo Oops, you forgot sudo!`

Should you need to produce more complex combinations, use the command combination operator. This allows you to group related commands with each other inside `()` characters, effectively treating them as their own separate command within the context of other commands.

The following example first checks for the existence of a file called linux.txt. If it exists, the first `echo` command is processed; if not, the commands inside the `()` operators are executed one after the other instead:

`$ test -f ~/Documents/linux.txt && echo linux.txt exists! || ( echo linux.txt doesn't exist – creating now.; touch ~/Documents/linux.txt; )`

Syntax is crucial – don't forget to leave a space between `(` and the command. Also make sure you include a trailing `;` at the end of the command to return to the shell after the final command is executed.

All about pipes

Pipes are special operators designed to redirect the output of one program into another command for further processing, typically to produce a different form of output. Pipes are formed using the `|` character, which is found by holding Shift as you press the backslash (`\`) key on most keyboards. The following example pipes the result of the `ls` directory listing command to the `less` command to produce a more screen-friendly format:

`$ ls -l | less`

Here's a clever use of the `wc` (word count) command and `-l` flag (list the number of lines) to list the number of objects in the listed directory:

`$ ls Documents | wc -l`

Pipes aren't simply used to display the output from one program in another – the following example allows you to download a video from YouTube (`sudo apt install youtube-dl` followed by `sudo pip install --upgrade youtube_dl`) and then run it through ffmpeg (`sudo apt install ffmpeg`) to produce an audio-only MP3 file:

`$ URL=https://www.youtube.com/watch?v=QvKBeOKvbII`

`$ youtube-dl $URL -q -o - | ffmpeg -i - audio.mp3`

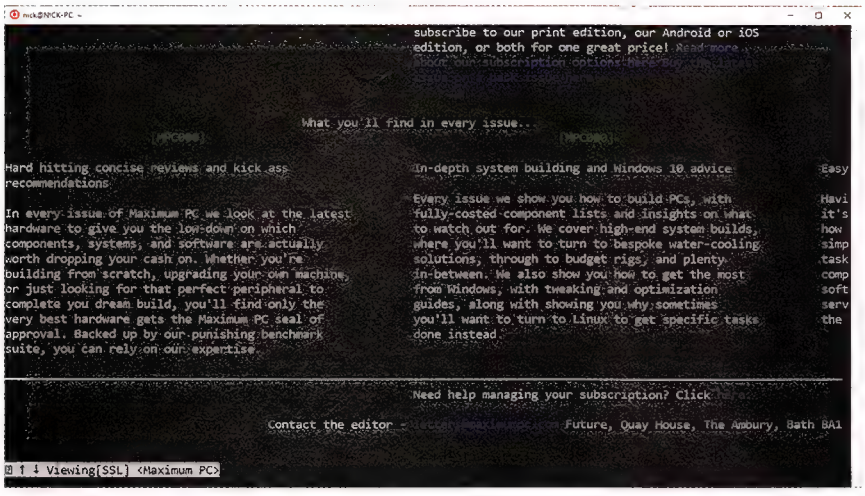
Finally, you can combine multiple piped outputs in the same way you can build complex chains using other operators:

`$ youtube-dl $URL -q -o - | ffmpeg -i - audio.mp3 && play audio.mp3`

Play music in Linux

The `play` command is part of the SoX tool, which you obviously need to install to play your converted music file. Install it with `sudo apt install sox libsox-fmt-all` . The `libsox-fmt-all` library includes support for proprietary formats, such as MP3.

Once installed, you can also use SoX in jukebox fashion by navigating to a folder containing some music and issuing the following command: `play *.mp3` . Press Ctrl-C to jump to the next track, or press it twice to stop playback. Type `play`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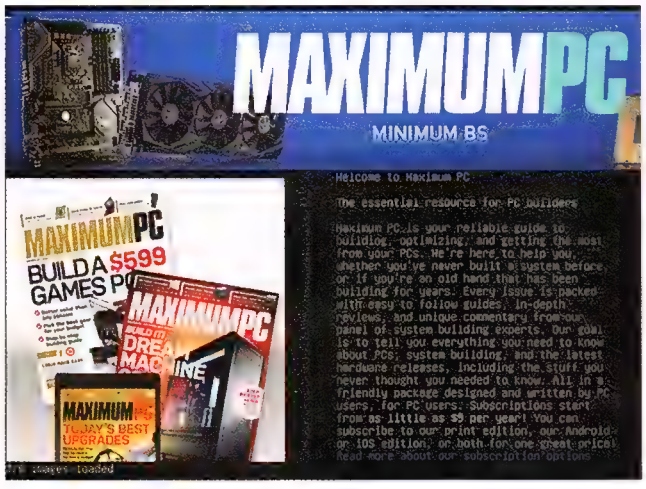
Need help managing your subscription? Click
Contact the editor
Future, Quay House, The Ambury, Bath BA1
Viewing[SSL] <Maximum PC>

The w3m browser is a text-only affair in the Terminal or Windows Linux subsystem...



...but does display images when you're running it from the Linux shell.

"You can combine multiple commands via different combinations of operators. For example, placing && and || together is like producing an IF... ELSE... statement"

`--help` to see a full list of options, including a wide range of effects and filters, such as:

```
$ play *.flac bass +2 gain +1 reverb
```

If you'd like a more interactive player, try `cmus` (`sudo apt install cmus`). Once launched, after a short pause you'll be shown a two-pane window. The app is controlled in a similar way to the Vi text editor – for example, to load your "Music" folder into the program:

```
:add ~/Music
```

You can then browse for tracks and playlists, and type `man cmus` for a detailed user guide. You can also plug in extra features via extension scripts – see **https://github.com/cmus/cmus/wiki** for more details.

Access internet resources

The internet is fully accessible from within the shell. Let's start things off with web browsing. The w3m-img browser can display web images from inside the shell (within a regular Terminal window or the Windows Linux subsystem, it only displays text). Install it with `sudo apt-get install w3m-img` . Once done, you can test it by heading to *APC*'s sister magazine site:

```
$ w3m www.maximumpc.com
```

Use the cursor (or mouse) to navigate around the page, hit Enter to visit hyperlinks and – if supported – you'll see images rendered inline as you scroll, while text is color-coded to aid navigation. Press q to quit – a full list of commands can be gleaned by pressing H.

Here's a neat little trick: looking for a weather forecast? Simply type `curl http://wttr.in/~your_city` and hit Enter for a three-day forecast, covering morning, noon, evening, and night. You'll need to resize your Terminal window for the full effect, though.

The shell is also a great place to download files – check out the box on the right for a range of tools for doing so. ■

Download files from the shell

How about downloading files from various online resources? The `wget` tool is your friend, capable of pulling content from HTTP, HTTPS, and FTP servers, like so:

```
$ wget "http://url.com/file.zip"
```

Add the `-O` flag if you would like to save to a different directory (`wget -O /home/username/Desktop/ http://url.com/file.tar`). As the file downloads, `wget` provides you with a progress bar, but if you're downloading a particularly large file, press Ctrl-C to cancel the current download, then use the `-b` flag to download in the background:

```
$ wget -b -O /home/username/Downloads/ http://url.com/download.iso
```

Type `ls -l -block-size=M` and hit Enter periodically to see how far the download has got by reviewing its file size.

A better tool for accessing FTP servers is the interactive ftp tool: type `ftp` and press Enter to get started. The cursor changes to "ftp>" so type the following to connect to a remote server:

```
ftp> open ftp.example.com
```

You're prompted to enter a username and password if required, and then you're in. Use the same tools you use to navigate your filesystem: `cd` for changing directories, `ls` to list directory contents, and so on.

Type `get filename` to download a file to the directory you were in when you invoked `ftp` , or `put filename` to upload it from the same directory.

Need to grab a file using BitTorrent? Start by installing rTorrent (`sudo apt install rtorrent`). Next, type `rtorrent` , and then press Enter twice to reveal the "load. normal>" line. Simply type or paste your torrent URL here and press Enter to load it. Now use the cursor keys to select the torrent file from the list, and press Ctrl-S to start the download. You can stop the download at any time using Ctrl-D, or quit rTorrent completely using Ctrl-Q.

System News

Intel launches its 10th lake. Mark Williams looks at why Intel is treading water in it.

The core wars between Intel and AMD continue to rage on. Intel has released its 10th Gen Core processor line-up (Comet Lake) and despite being on the back foot, still stuck on its 14nm++ process node (the number of pluses one can append to that is something of a humorous meme in the industry now), it has put out some products that are not only better than the outgoing 9th Gen parts but continue to go toe-to-toe with AMD's parts.

With no architectural improvements, Intel is scraping the bottom of the barrel in terms of pushing what the silicon can do and is finding innovative ways of taking advantage of the one solid strength it is still king of the hill of: clock speeds.

Intel's parts clock very high in stock trim, into the high 4GHz range and with the 10th Gen into the low 5GHz, and Intel has been working hard to allow its processors to boost higher and for longer to maintain those peak clocks by adding yet more turbo boosting algorithms. A list which now includes: Turbo Boost 1.0, Turbo Boost 2.0, Turbo Boost Max 3.0 and Thermal Velocity Boost. All of which work together to give you the highest clocks possible at any point in time. Combined, they're not quite as advanced as AMD's singular Precision Boost 2 technologym, which has that company's processors clock almost like a GPU in that clocks mostly depend on temperatures, but it's getting close and it's enough to keep Intel well ahead in gaming titles.

Intel is also sanding down the tops of the CPU dies it's making to further enhance thermal conductivity to the IHS and heatsink to improve thermals on what are very power hungry and hot processors.

Despite Intel being stuck in the mud, it is still swinging hard and AMD while broadly with the technical lead overall, isn't so far ahead that it can dominate the market yet. It must make you wonder what Intel will pull out of its hat when it finally does figure out 10nm and drops its new IPC improved microarchitecture. AMD has got to be worried about that looming scenario.

MARK WILLIAMS
Mark is an IT professional with a strong interest in voiding warranties.

Speaking with Richard from Aftershock PC, it's obvious that AMD is still outselling Intel quite comfortably, and that Intel is still having a hard time with supply from its constrained 14nm fabs, with 10900K shortages a-plenty.

The two things that hurt Intel, still is pricing and segmentation within its own line-up. Intel is still selling locked and unlocked processors, and selling only one chipset – its most expensive one – that can overclock.

This leaves a situation where the somewhat reasonably priced i5-10600K must be mated with a Z490 motherboard to achieve its full potential, something which is double the price of an AMD B450 motherboard. At least the LGA1200 socket is guaranteed to offer one extra generation of CPU support – something Intel hasn't done in the consumer segment for an awfully long time.

Intel is treading water at the moment and has done enough this generation to remain a relevant – if relatively pricey – choice if its specialty meets your requirements. With AMD's Zen 3 architecture due out later this year, however, Intel could soon find itself in deep water. Its 10nm node for desktop processors can't come soon enough.

Shop Talk

What are your thoughts on Intel's new 10th-gen CPUs? How popular are they with customers and how has availability been?

RICHARD, AFTERSHOCK PC:

"We have not seen a big uptake in the new Intel 10th Gen CPUs, AMD still seems to be dominating, especially with its recent price drops. Availability of the lower end units has been ok, however given there are only Z490 motherboards available for them, it doesn't really make a lot of sense as it's an expensive motherboard with a lower end CPU. The 10900 and 10900K are very difficult to get, yet the appropriate matching Z490 motherboards are the only ones available. We have seen the biggest uptake in the 10700k as using a Z490 motherboard with it still works as a good combination. The 10600k has only been a trickle for us at the moment."

Market snapshot

A sampling of PC systems available this month.

$4,399 | tinyurl.com/APC483AFT

Aftershock PC Ultracore

Set in a showy Lian Li O11D, this system has all the underpinnings of a great gaming rig. A water-cooled i7-10700K has much of the speed of an i9 for gaming and with some minor overclocking tweaks, equal performance. With eight cores you'd think it wouldn't be as competitive in multi-threaded productivity tasks, but with such high clock speeds it does rather well. A speedy RAM pairing is nice to see, as is a comfortably sized 1TB NVMe SSD for all your OS, gaming and project needs plus a 2TB hard drive for everything else. With ample custom cosmetic choices at checkout, this could be the glitzy system you've been waiting for.

CPU: Intel Core i7-10700K, **COOLER:** Aftershock Spectra Glacier 240mm, **MOTHERBOARD:** Asrock Z490 Steel Legend, **GRAPHICS:** Asus ROG Strix RTX 2080 Super 8GB, **MEMORY:** 16GB DDR4 3600MHz Gigabyte Aorus RGB, **STORAGE:** 1TB M.2 NVME SSD, 2TB 7200RPM HDD, **POWER SUPPLY:** FSP / EVGA 850W, **CASE:** Lian Li O11D

$5,439 | tinyurl.com/APC483PLE

PLE Computers Gen10 Electro

Wanting a no compromise ultimate gaming experience? This is what you should be looking for. Sporting Intel's new top of the line 10th-gen Core i9 processor, not only will it rip through frame rates quickly, it'll perform well in production heavy multi-threaded tasks too thanks to its deca-core design. The perfect pairing of an RTX 2080 Ti will further satiate your frame rate desires, be it at 1440p or 4K resolutions. Storage is an all SSD affair – 500GB of fast SSD storage for your OS and games plus a slower but still nimble 1TB SSD drive for everything else. With RGB everywhere including the power connectors, this looks as good as it performs.

CPU: Intel Core i9 10900K, **COOLER:** Nzxt Kraken X53 240mm AIO, **MOTHERBOARD:** Gigabyte Z490 Aorus Elite AC, **GRAPHICS:** Gigabyte GeForce RTX2080Ti Gaming OC 11GB, **MEMORY:** GeIL 16GB Kit DDR4 Super Luce RGB C16 3000MHz, **STORAGE:** Samsung 970 EVO Plus 500GB, Samsung 860 QVO 1TB SSD, **POWER SUPPLY:** eVGA Supernova G1+ 850W, **CASE:** Nzxt H510i

$4,499 | tinyurl.com/APC483PCC

PC Case Gear Lightning 2080 Ti

This rig sports Intel's 10th-gen eight-core 10700K paired with a top of the line RTX 2080 Ti, so will be no slouch when it comes to high FPS gaming.
One thing that seems odd is the 240mm AIO radiator – it looks diminutive relative to the size of the case. A 280mm AIO would've fit nicely instead and would do a better job of cooling this power hungry and hot processor. Overclocking mileage may vary. The power supply wattage is ok for stock running but keep an eye on power draw if overclocking. Apart from that, PC Case Gear is shoehorning in an impressive amount of compute power for the price.

CPU: Intel Core i7 10700K, **COOLER:** Cooler Master MasterLiquid ML240R ARGB AIO, **MOTHERBOARD:** MSI MAG Z490 Tomahawk, **GRAPHICS:** MSI GeForce RTX 2080 Ti Ventus GP OC 11GB, **MEMORY:** Team T-Force Delta RGB 16GB 3200MHz CL16 DDR4 Black, **STORAGE:** Adata XPG SX8100 M.2 NVMe SSD 512GB, Seagate Barracuda 2TB HDD, **POWER SUPPLY:** Super Flower Leadex III 650W, **CASE:** Cooler Master MasterCase H500P

$3,299 | tinyurl.com/APC483SCP

Scorptec Pandora RTX 2080 Super

If you're all about high resolution gaming with the graphic details cranked way up, this could be the system for you. While the Ryzen 3700X is ample enough for any modern game, it's not quite as good as Intel's equivalent if you're aiming for 144Hz+ fps. Putting the bottleneck on the GPU with high game details, however, you wouldn't see a difference compared to any Intel system, apart from the price as there is a big gap to an equivalent 10700K system (see the Aftershock system for example).

CPU: AMD Ryzen 7 3700X, **COOLER:** OEM, **MOTHERBOARD:** Gigabyte Aorus B450 Pro WIFI, **GRAPHICS:** Gigabyte Windforce GeForce RTX 2080 Super OC 8GB, **MEMORY:** Corsair Vengeance RGB Pro 16GB 3000MHz DDR4, **STORAGE:** Western Digital Blue SN550 500GB M.2 SSD, Seagate BarraCuda 2TB HDD, **POWER SUPPLY:** SilverStone Strider 650W, **CASE:** Corsair iCue 465X

BLUEPRINTS

VALUE- AND PERFORMANCE-DRIVEN HYPOTHETICAL BUILDS

PC BUILDER

Budget

When beans matter.

Welcome to the new-and-improved *APC* Blueprints! We're happy to announce that we're shaking things up in this section, and from now on we'll be including both an Intel and an AMD build for each tier. To kick things off, let's take a look at our new budget builds. Our AMD build has changed only a little from last month, with the big change here being the jump away from Nvidia to AMD's Radeon RX 5600 XT 6GB, specifically Asrock's Challenger D model. Now, we're not going to be sticking rigidly to only using AMD GPUs in the AMD builds each issue, but it felt appropriate this time around. This AMD machine was cheaper overall than the budget Intel build, so splashing out on the 5600 XT was an easy choice, giving it a small graphical performance edge over its Intel counterpart, which uses the GTX 1660 Super.

Motherboard pricing was tricky here. B450 boards make building budget AMD systems relatively easy, while the only sensible option for Intel is a Z300-series board, which is a bit pricier. Without one of these, you'll forgo the ability to overclock the Core i5-9600K processor we're using. Speaking of the processor, its performance runs close to the Ryzen 5 3600; it struggles in some areas due to its six threads (versus the 3600's 12), but it's still a very competent gaming CPU.

Overall, we'd give the lead to the AMD build this issue, but the Intel build's performance isn't to be sniffed at. The Intel system isn't so affected by memory frequency, so you should be able to save some cash by sticking at 2,400MHz, but a sweet sale on the 3,000MHz T-Force Vulcan Z memory puts the AMD build in excellent standing this month. The final key advantage of the Ryzen 5 3600 is support for PCIe 4.0 SSDs, but it's a dubious victory in the budget arena since you'll need a B550 motherboard.

"Motherboard pricing was tricky here. B450 boards make building budget AMD systems relatively easy, while the only sensible option for Intel is a Z300-series board, which is a bit pricier. Without one of these, you'll forgo the ability to overclock the Core i5-9600K processor we're using. "

AMD INGREDIENTS

PART		PRICE
CASE	BITFENIX NOVA TG	$120
PSU	EVGA 400 N1 400W	$59
M/BOARD	MSI PRO B450M	$119
CPU	AMD RYZEN 5 3600	$299
GPU	ASROCK CHALLENGER D RX 5600 XT 6GB	$499
RAM	16GB (2X 8GB) TEAM T-FORCE VULCAN Z @ 3,000MHZ	$100
SSD	120GB ADATA SU650 T 2.5" SATA III	$56
HDD	1TB SEAGATE BARRACUDA HDD	$70
OS	UBUNTU DESKTOP LINUX 18.04.3 LTS 64-BIT	$0
PRICE:		$1,322

INTEL INGREDIENTS

PART		PRICE
CASE	BITFENIX NOVA TG	$120
PSU	EVGA 400 N1 400W	$80
M/BOARD	ASROCK Z390 PRO4	$299
CPU	INTEL CORE I5-9600K	$320
GPU	GIGABYTE GEFORCE GTX 1660 SUPER 6GB	$499
RAM	16GB (2 X 8GB) GEIL EVO POTENZA @ 2,400MHZ	$110
SSD	120GB ADATA SU650 T 2.5" SATA III	$56
HDD	1TB SEAGATE BARRACUDA HDD	$70
OS	UBUNTU DESKTOP LINUX 18.04.3 LTS 64-BIT	$0
PRICE:		$1,564

"Both builds have powerful 1440p GPUs, the MSI Radeon RX 5700 and the Gigabyte GeForce RTX 2060 OC. The former has additional VRAM that affords it slightly superior performance, but the 2060 is a cheaper (and in many games, more reliable) card."

PC BUILDER

Mid-range

Packing some punch.

We know a few components are shared between the two builds, but don't fret – we're going to be diversifying each pair of builds further with each coming issue. You may also have noticed that we're pumping up the average power of the builds, so they'll be a bit more expensive but with an increase in performance.

Processor-wise, we've got the AMD Ryzen 7 3700X against the Intel Core i7-9700F. Opting for the F variant rather than the more expensive i7-9700K loses us integrated graphics and a small amount of overclocking headroom, but that shouldn't be a problem. The Ryzen 7 3700X is cheaper and manages to outperform the 9700F in some areas thanks to simultaneous multi-threading, but the Intel chip remains superior for gaming.

Both builds have powerful 1440p GPUs, the MSI Radeon RX 5700 and the Gigabyte GeForce RTX 2060 OC. The former has additional VRAM that affords it slightly superior performance, but the 2060 is a cheaper (and in many games, more reliable) card. The 2060 also has ray-tracing capabilities, in theory a major feather in its cap against AMD, but in reality the 2060 isn't that well equipped to handle ray tracing in most games.

The AMD system now packs a fourth-generation PCIe M.2 SSD, the Corsair Force MP600, giving it a major advantage over the Intel build in file transfer speed thanks to its 3rd-gen Ryzen chip and X570 motherboard. The Intel build retains the more affordable Western Digital SN750 SSD. Both systems are rocking twin-fan air coolers for their respective CPUs: The Corsair A500 for the AMD build, and the Noctua NH-U12A for the Intel one.

Elsewhere, we're pulling some components over from the budget build for now, namely the memory and hard drives. Keep an eye on these: We're watching component prices closely, and we'll be introducing more variety soon.

AMD INGREDIENTS

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	$189
PSU	600W EVGA 600 BQ	$169
M/BOARD	GIGABYTE X570 AORUS ELITE	$379
CPU	RYZEN 7 3700X	$415
COOLER	CORSAIR A500 DUAL FAN	$159
GPU	MSI RADEON RX 5700 8GB	$699
RAM	16GB (2 X 8GB) TEAM T-FORCE VULCAN Z @ 3,000MHZ	$120
SSD	500GB CORSAIR FORCE MP600	$225
HDD	1TB SEAGATE BARRACUDA HDD	$70
OS	WINDOWS 10 HOME 64-BIT OEM	$140
PRICE:		$2,565

INTEL INGREDIENTS

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	$189
PSU	600W EVGA 600 BQ	$169
M/BOARD	MSI MPG Z390 GAMING PLUS	$229
CPU	INTEL CORE I7-9700F	$599
COOLER	NOCTUA NH-U12A	$209
GPU	GIGABYTE GEFORCE RTX 2060 OC 6GB	$699
RAM	16GB (2 X 8GB) GEIL EVO POTENZA @ 2,400MHZ	$110
SSD	500GB WESTERN DIGITAL WD BLACK SN750 M.2 PCIE SSD	$199
HDD	1TB SEAGATE BARRACUDA HDD	$70
OS	WINDOWS 10 HOME 64-BIT OEM	$140
PRICE:		$2,613

PC BUILDER

Turbo

Maximum power computing.

This one is trickier to compare. It goes without saying that the Threadripper chip wipes the floor with the i9-9900K in most CPU-intensive tasks, although the Intel processor is both cheaper and often the better choice if you're gaming. It also keeps the build from getting too pricey in other areas. Cheaper, lower-speed memory is more viable than with the Threadripper 2950X, and X399 motherboards are almost universally on the steep side, while Z390 boards vary significantly in price, allowing us to pick out something good but still sensible. We've opted for the Asus TUF Z390-Plus Gaming, a high-quality board at a reasonable price, while the AMD build retains the ASRock X399 Taichi.

We've taken those savings and reinvested them, aiming to keep the price points of these two builds as close together as possible. We splashed out on a slightly more expensive RTX 2080 Super on the Intel build, going with EVGA's factory-overclocked model rather than the Gigabyte card still sitting in the AMD build. In another bold move, we're also using the excess cash to upgrade to Gigabyte's super-flashy 280mm Aorus RGB AIO cooler. Yes, it's definitely expensive for a two-fan AIO cooler, but it brings RGB-lit fans and a full-color LCD display atop the pump block, which can be customised to display live stats, such as your CPU temperature. It's a seriously cool product, and you can consider it our Upgrade of the M – no, wait, we're not doing that anymore, are we?

The Intel build keeps the RGB lighting coming with its memory: The Corsair Vengeance RGB Pro, to be precise, with 32GB of capacity and a frequency 2,666MHz. The AMD build has rainbow RAM too, but the need for higher memory speed means that the G.Skill TridentZ kit we used is more expensive. Both builds are using BarraCuda SSDs and HDDs from the ol' reliable that is Seagate, making for 7TB of storage per build. Again, watch this space, as we've got big plans. The 3rd gen of Threadrippers is finally calling, and 10-series Intel chips are knocking on the door too.

"In another bold move, we're also using the excess cash to upgrade to Gigabyte's super-flashy 280mm Aorus RGB AIO cooler."

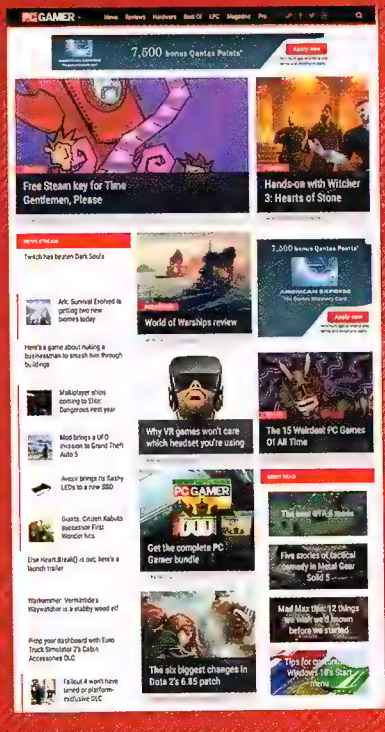
AMD INGREDIENTS

PART		PRICE
CASE	NZXT H710I	$309
PSU	850W CORSAIR RM850X 80+ GOLD	$259
MOBO	ASROCK X399 TAICHI STR4	$569
CPU	AMD THREADRIPPER 2950X	$1,299
COOLER	CORSAIR ICUE H115I RGB PRO XT 280MM	$219
GPU	GIGABYTE GEFORCE RTX 2080 SUPER GAMING OC WHITE 8GB	$1,399
RAM	32GB (2 X 16GB) G.SKILL TRIDENTZ RGB @ 3600MHZ	$399
SSD	1TB SEAGATE BARRACUDA 510 M.2 PCIE SSD	$285
HDD	2X 3TB SEAGATE BARRACUDA HDD	$290
OS	WINDOWS 10 HOMES 64-BIT OEM	$140
PRICE:		$5,168

INTEL INGREDIENTS

PART		PRICE
CASE	NZXT H710I	$309
PSU	850W CORSAIR RM850X 80+ GOLD	$259
MOBO	ASUS TUF Z390-PLUS GAMING	$299
CPU	INTEL CORE I9-9900K	$899
COOLER	GIGABYTE AORUS RGB LIQUID COOLER 280MM	$309
GPU	EVGA GEFORCE RTX 2080 SUPER BLACK GAMING 8GB	$1,349
RAM	32GB (2 X 16GB) CORSAIR VENGEANCE RGB PRO @ 2,666MHZ	$299
SSD	1TB SEAGATE BARRACUDA 510 M.2 PCIE SSD	$285
HDD	2X 3TB SEAGATE BARRACUDA HDD	$290
OS	WINDOWS 10 HOMES 64-BIT OEM	$140
PRICE:		$4,438

SMARTER COOKIES ENABLED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QUICK TIPS

APC experts solve computing problems

The *APC* team tackle problems across the spectrum of devices and software we use. Learn a new trick or fix you can use.

AMD USB problems

I have an AMD R9 3900X build with an MSI X570 MPG Gaming Pro Carbon motherboard. I was having thermal issues with the voltage regulator modules, which meant the CPU was being throttled when the VRMs hit 95 degrees Celsius. I decided to replace the mobo with an Asus ROG X570 Crosshair Hero VIII, which runs a lot cooler.

I originally stuck with the same Windows install, which settled down after several reboots and driver updates, but have now run into some weird issues. USB flash drives are only recognized 50 percent of the time when plugged into any USB 3.0 port, forcing me to unplug and reinsert them. Sometimes I get an error saying the USB device wasn't removed properly, even when nothing is plugged into it!

Also, when the PC starts, it occasionally boots to a blurry login screen, but the login box does not appear, so I'm forced to reboot. I had to disable Quick Start to get around this issue. Finally, Device Manager shows an error: "Unknown USB Device (Device Descriptor Request Failed)." I've tried uninstalling and disabling the device, but the error always appears.

I did a complete fresh install of Windows 10 Pro as a last resort. After the fresh install, the Windows errors were still present, so I'm thinking the issue may be the motherboard. I hope you can provide me with some guidance. Thank you.

JON SHIMAMOTO

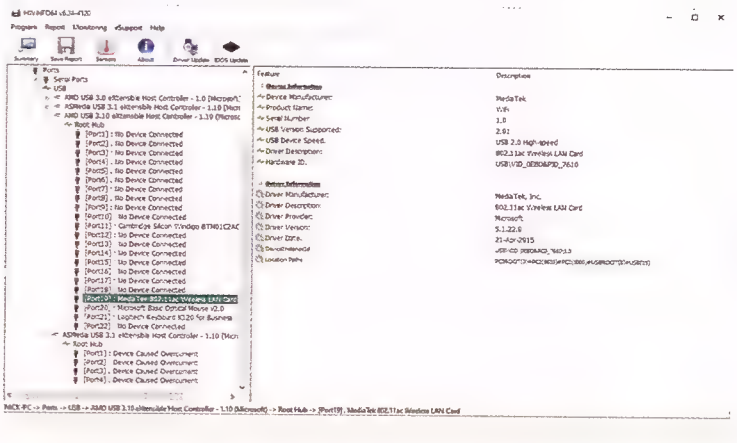
APC responds: It pays to pair a brand new motherboard with a fresh Windows install – wiping the hard drive completely clean, then performing a factory-fresh install with no traces of any old systems left. We assume it's what you've (belatedly) done here.

The fact the problem has persisted means something isn't right, however. You could try RMAing the board, but an online search reveals numerous complaints about USBs on AMD chipsets. It means your issues could be down to anything from voltage settings or memory timings to drivers or USB power-saving settings. It's worth troubleshooting further before returning your board.

A good tool for tracking down the source of USB problems is HWinfo (**www.hwinfo.com**). In your case, the device descriptor error should point to a specific port – open HWinfo's main screen, then expand "Ports > Serial Ports > USB > AMD 3.10 eXtensible Host Controller – 1.10 (Microsoft)." A list of all ports will be shown, along with the devices connected to each port. Selecting this should hopefully help you identify which device is causing the problem, allowing you to investigate further.

For more general troubleshooting, start by making sure you've got the latest BIOS update (dated March 20th) installed, and while you're at it, visit **https://bit.ly/MPCAsus** to see what drivers are available. If nothing shows up in the driver search, you may need to whitelist the site with your ad-blocker to make them visible. The obvious driver to install here is the chipset one, but there's been reports that these are less stable than the ones supplied by Windows, so consider rolling back to the Windows ones to see if that improves matters.

Finally, others have traced their problems to the AMD Ryzen power plan – it's not enough to simply switch to another plan, you need to remove the plan too. First, verify it exists: type "power plan" into the search box and click "Choose a power plan." If an AMD Ryzen entry is present, first switch to another plan (say "Balanced"). Next, click "Change plan settings" next to the AMD Ryzen plan and click "Delete this plan" to remove it. If the problem persists, access your new plan's advanced power settings, expanding the USB section and disabling USB selective suspend.



HWInfo can help isolate the cause of USB problems.

Fix filesystem corruption

My Windows 10 64-bit system was reliable for years, but then began to hang for brief periods. After a fruitless search, someone suggested it might be down to a bad spot on the drive – I ran "chkdsk" and it found an error. I re-ran it, instructing it to repair the problem – it finished, rebooted, and then told me the filesystem was corrupt. I used a recovery boot CD and expected to find that the drive was empty, but all my files are still there. I've tried searching for any utility that might fix the filesystem problem but found nothing. Is there anything out there that might be able to repair the filesystem?

BILL SIMPSON

APC responds: In an ideal world, we'd focus on recovering the specific program you want to save, but

without knowing what it is we can't determine whether you need to recover a product key (which may be stored in the Registry) or source an installer for that specific version of the program in order to resurrect it – and that's before saving any configuration settings.

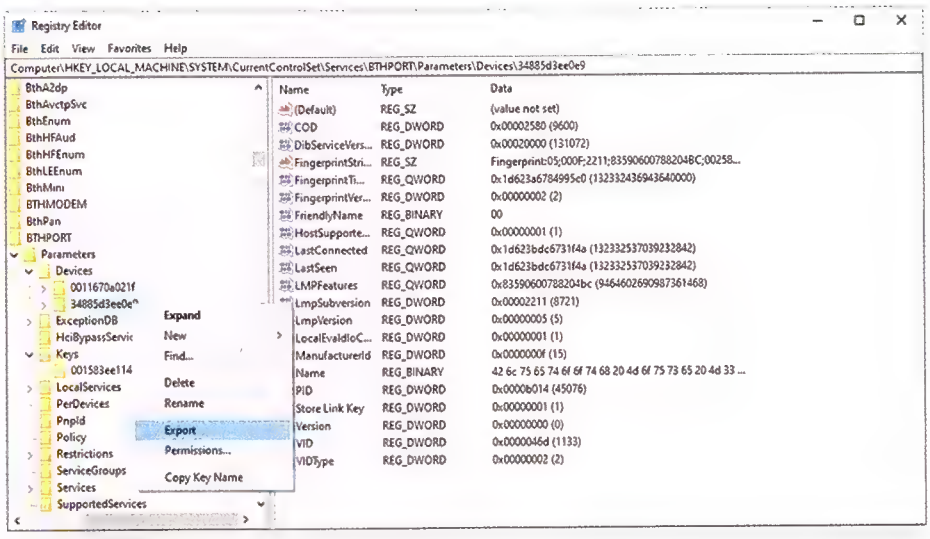
There's a tool that enables you to take a fail-safe image of the entire hard drive before attempting to repair the filesystem. That tool is Lazesoft Recovery Suite (**www.lazesoft.com/lazesoft-recovery-suite-free.html**). Install it on a working PC and use it to create a bootable USB flash drive or DVD to run on your afflicted PC.

Once done, boot your troublesome PC from the rescue media. Start by selecting "Lazesoft Disk Image & Clone" and choosing "Drive to Image" to create a VHD image of the entire drive on a backup drive. If all else fails, you'll be able to access this VHD image in a number of ways – "mounted" like an actual physical disk using a free tool like OSFMount (**https://bit.ly/MPCMount**) to enable you to browse its contents and copy off individual items, for example. It can also be attached to a virtual machine using Virtualbox, or copied back to another hard drive (handy if you'd discovered your non-working PC's drive was physically damaged).

With this fail-safe backup in place, you can then return to the main Lazesoft menu and choose "Windows Recovery." Try the "One Click Fix" solution first – if it fails, undo it, then try "chkdsk" on the "BootCrash" tab, followed by "Check Partitions" and "Additional Tools > Run SFC." Still no luck? The "FinalSolution" will guide you through a Windows reinstall – you may be able to perform a repair install from here to bring Windows back again without losing any data or access to your program.

Wipe or upgrade?

I'm finally ready to ditch Windows 7 for Windows 10. I've downloaded the free upgrade to a USB drive following your column in the August 2019 issue. My question is how to prep for this upgrade. I've always wiped the hard drive to do a clean install. Since this free Windows 10 upgrade didn't come in a shrink-wrapped factory package CD with new registration code, must I install it on top of Windows 7?
DAVID MARSHALL



The Registry holds the key to pairing a device to two installs.

APC responds: Follow our advice and upgrade over the top of your existing Windows 7 installation – this will ensure that a valid digital license for Windows 10 Home is produced for your PC (after installation completes, open Settings and search for "see if Windows is activated" to confirm it's worked – at time of writing, you are still able to get a free upgrade). Once you've got that, and linked it to a Microsoft account, feel free to wipe the drive and reinstall Windows 10 from scratch.

Pair device twice

I've got a Bluetooth mouse I'd like to use on a dual-boot system, but each time I pair it with one Windows 10 installation, it won't then connect to the other unless I perform the pairing dance again. Other Bluetooth devices don't have this problem – can I get the mouse to stay paired to both devices at the same time?
JAKE WILKINS

APC responds: Most Bluetooth mice (and keyboards) can only be paired with a single OS or machine at one time. Multi-device peripherals exist – for example, Logitech's MK850 combines Bluetooth mouse and keyboard with support for up to three devices.

You can, however, see if you can trick your Bluetooth mouse into thinking your two Windows installations are one and the same. This relies on both installations sharing the same Bluetooth dongle (if you're feeling brave, you may be able to adapt this to work on two separate Windows PCs, so long as you remember to swap the Bluetooth adapter between each machine). Step one is to pair your mouse with the first Windows partition. Once done, repeat for your second partition. As things stand, the mouse works with partition two, but not partition one. While still in partition two, open "Settings > Devices" and click "Devices and Printers" to open Control Panel. Double-click your Bluetooth mouse to open a "Properties" screen, switch to the "Bluetooth" tab and make a note of its unique identifier.

Next, press Win-R, type "regedit" and hit Enter. Browse to the following key: "HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\BTHPORT\Parameters\Keys." Expand this, and you should find a subkey with a unique alphanumeric name (such as 001583ee1140) that refers to your Bluetooth adapter. Inside this will be a value that matches your mouse's unique identifier. Right-click the subkey and choose "Export" to save it as a REG in a location accessible to partition one. Expand the "Devices key" above "Keys" – you'll find a subkey that matches your mouse's ID. Export this key too.

Attach a wired mouse to your PC and reboot into partition one. The Bluetooth mouse will stop working, but import the two REG files you created (double-click each in turn and follow the prompts to merge them into the Registry) and reboot again into partition one. You should now have access in both installations.

WINDOWS

Benchmark your GPU like *APC*

See how your rig stacks up.

Last issue, we showed you how to benchmark your CPU just like the system-testing impresarios here on *APC*. Never let it be said that we can't follow a theme; this time, we'll be running through the tests we often use to benchmark GPUs, for both builds and reviews.

Unlike our CPU benchmarking process, some of this software isn't available for free. Free trials are available for certain programs, but GPU testing ideally uses multiple gaming benchmarks, which could cost you. We'll go through some of the games we use for testing later on, but if you don't have any of those you may want to look into whether any of the titles you already own include a benchmark. Plenty of games have one nestled away in the graphical settings to let you double-check you're getting optimal performance from your machine.

It's worth noting that the following benchmarking tests are ones we primarily use for testing on discrete GPUs, not integrated graphics on CPUs. Many of these tests can be run on modern IGPUs without issue – albeit generating very low scores – but take care if you do want to stress test your chip's graphics. These tests can push IGPUs to their limits, and you don't want to risk damaging your processor (or your whole system) due to overheating.

Even the mightiest of GPUs need testing from time to time.

YOU'LL NEED THIS

A PC or laptop with a discrete graphics card

A screen, mouse, keyboard, and internet connection.

Some money to spend on benchmarking software.

1 Strike while the iron is hot

We're going to jump straight in with 3DMark from UL Benchmarks. This is the single most comprehensive and widely acknowledged graphics test available right now, with a large variety of comparative score tables available online for any class of PC. 3DMark is available online (or through Steam, for added convenience), and the Advanced Edition costs US$30.

It's no small investment just to test your graphics card, sure, but 3DMark is a powerful and comprehensive piece of software; shell out for the Advanced Edition and you get multiple tests, each designed to test systems with varying levels of graphical power. Our go-to test here is Fire Strike, a multipurpose DirectX 11 gaming test for discrete GPUs. Fire Strike takes a little while to run, rendering some cool fight scenes in a sci-fi landscape. It's fun to watch – for the first few times, at least.

If you open up 3DMark and head to the "Benchmarks" tab, you should be able to launch Fire Strike by simply selecting it and hitting "Run". If you've got the Advanced Edition, you should also have access to Fire Strike Extreme and Fire Strike Ultra; while the regular version of the benchmark runs at 1080p, these run at 1440p and 4K respectively. We'd avoid them unless you have a high-end GPU, as they kick the living daylights out of your card.

Fire Strike has the same composition as most of 3DMark's tests; first, it tests graphical rendering, then physics, then finally a combined stress test. It then spits out a number that will at first appear meaningless, but don't despair; this is your system's index score, and you can use 3DMark to compare it to other, similar machines. There are also high-score leaderboards, where tweakers with overpowered PCs compete for the best performance.

2 Ray-traced testing

3DMark offers more specific tests, too. If you are running on integrated graphics (or an older system), you might want to check out Sky Diver, a graphical test similar to Fire Strike, but for lower-spec machines. Time Spy and Night Raid offer similar tests, but for systems running DirectX 12 in games. There's also Port Royal, which is used to test the ray-tracing and DLSS capabilities of PCs with Nvidia's RTX GPUs.

There's more specific options, such as tests for GPU API

Fire Strike is our go-to benchmark test for any new GPU.

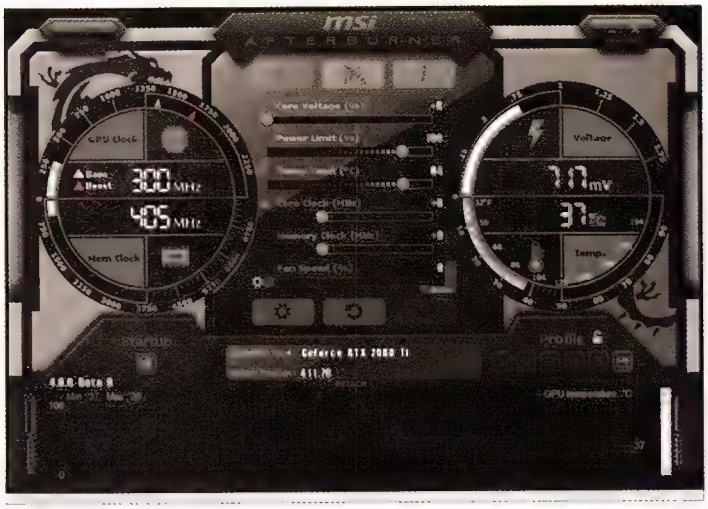
Frame rate checking

For real-time tracking of frame rates in games, you may need some extra software. While some games include live fps counters (like *Destiny 2*), you'll likely need to activate a separate overlay to monitor your frame rate while playing. If you're on Steam, then good news: Steam packs an in-game overlay that includes an fps counter. You can turn it on under "Settings > In-Game," and then it'll activate automatically in any game you boot up. You can't turn it on while playing, though.

Otherwise, you're going to need some external software. Unfortunately this does mean there's a bit of extra load on your CPU, but you shouldn't notice much of a difference on modern systems. The GPU overclocking software MSI Afterburner is our go-to program for this, as it can display a number of other live stats in an overlay. It's free to download and can be used to track things like GPU temperatures and clocks, as well as your frame rate. Afterburner is, however, a rather arcane piece of software. The UI is busy and unnecessarily stylised, which might prove annoying for some. Thankfully, there's a good alternative for those who like to keep things simple.

Fraps (known as FRAPS, if you like yelling) is another piece of software that can be used for monitoring your frame rate. Its primary use is for screenshot and video capture, but the free version enables you to pop up an fps counter on a hotkey when you're gaming. It's useful for making checks if you're experiencing frame drop, but easy to hide so your UI won't get too cluttered in games.

Fraps might look and feel a bit dated, but it's an effective tool, with a simple, easy-to-use interface that won't bash your CPU while it's running, so we recommend it. If you're not looking to overclock your GPU, we'd recommend it over Afterburner.



overhead and a PCIe test to demonstrate the improvements in PCIe 4.0, but we won't get stuck into that now as we don't typically use these in a standard GPU test. Ray tracing is still of interest, though.

For a more practical test of the ray-tracing capabilities of a GPU, we use a game: Deep Silver's *Metro Exodus*. This benchmark is quite fiddly to run: while most games will simply include a benchmark somewhere in the graphical settings menu, the *Metro Exodus* benchmark is hidden away in the game files on your PC. Assuming you haven't moved the files around, you'll find it in your installation folder for the launcher (be it Epic or Steam), under *Metro Exodus*. It's simply called "Benchmark.exe", but if you run it as an administrator you'll be met with a settings menu before the test begins. Select your target resolution and graphical level – we usually test at 1080p Ultra – and then run the benchmark. It will render a set cutscene demonstrating a range of effects, from particle physics to lighting, then give you an average frame rate.

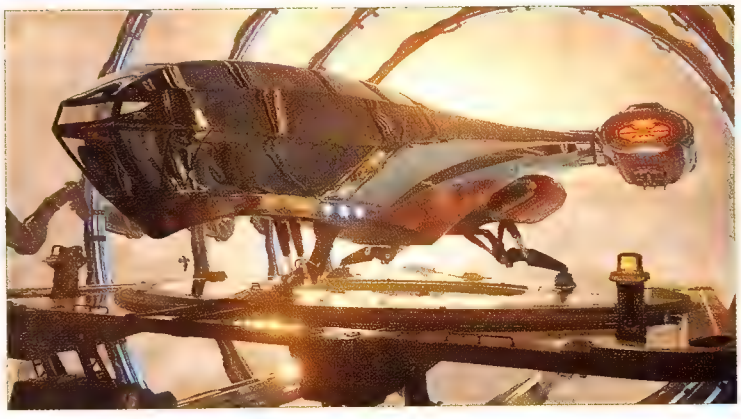
Averaged frame rates in games are the most useful piece of information about any GPU. Any game benchmark should be designed to give you an average frames-per-second score that matches your actual in-game experience, although it's also worth noting the minimum fps the test hits; this will give you an idea of any frame rate drop you might experience. With *Metro Exodus*, you can turn on ray tracing (while leaving the other settings intact) and run the test again to see how much using the RTX features will affect your frame rate.

3 Keeping score

Getting benchmark results is great, and frame rates are even better. But it's vitally important to keep track of not just how well your GPU is performing, but also how hot it's getting – doubly so if you're overclocking that GPU. A word to the wise on overclocking; do your research first, as many graphics cards won't give you much better performance on a manual overclock compared to the factory boost option, and your GPU's thermals are almost guaranteed to rise higher on a manual overclock.

We don't manually overclock GPUs during any testing we do, but we do take advantage of any automatic boost options available through manufacturer software, and we always make sure that the card is running the latest drivers. If you're benchmarking your system to check your overclocking performance gains, ensure that everything you're running is up to date, from the drivers to the benchmarks themselves.

For keeping an eye on your GPU temperature – among other things



If you have an RTX card, check out 3DMark's Port Royal ray-tracing benchmark.

Budget benchmarking

While most of the software and games we've listed here aren't free, there are still ways to test your GPU's capabilities without spending a dime. 3DMark has a free edition with limited features, but if you don't want to pay, we'd recommend Unigine's Heaven benchmark. The Heaven benchmark is a heavy-duty graphics test that can be used for systems running DirectX 11 and OpenGL 4.0, testing all the usual elements, such as ambient occlusion and real-time lighting. A free "gamer: edition" of the benchmark is available online, with the paid versions offering additional (often unneeded) features, such as benchmark looping and frame-by-frame analysis. Heaven is straightforward to set up and run, and comes with a few useful GPU monitoring tools too.

Another way to benchmark your system is to use free-to-play games in conjunction with fps-monitoring software (see "Frame rate Checking"). Using MSI Afterburner to track a continuous average fps and then playing a few matches in *Fortnite* will give you an idea of what your GPU can handle. Be sure to pause fps tracking when you're on menus and loading screens, as this won't be indicative of a real gameplay frame rate. Other free games that are worth checking out for fps testing include *Call of Duty: Warzone*, *Destiny 2: New Light*, and *Counter-Strike: Global Offensive*. We're also gonna give a shout-out to *World of Tanks*, as it has a built-in benchmark – a rare sight in free-to-play games!

PassMark PerformanceTest is a popular option for GPU benchmarking (and system testing as a whole). It's not free, but a trial version is available that should enable you to check if your GPU is performing as expected. Leaderboards for GPUs are available on the PassMark website too, which is useful if you're trying to overclock for max performance.

– when benchmarking, we recommend HWMonitor (also known as HardwareMonitor) from CPUID. It's a free download with no in-program ads, simply displaying a wide variety of live operating statistics for your PC. The UI is as basic as they come, and there aren't any extra features: just the numbers, with a running minimum and maximum on screen until you reset it.

The live figures are helpful for quickly checking temperatures, but the tracked maximum numbers are what help us during testing. Open up HWMonitor and leave it running in the background as you run a benchmark, then check what maximum GPU temperature your system reached during the test. Keep an eye on this, as different benchmarks will push your GPU to varying temperatures. If an intensive test pushes your card to very high temperatures, it may be a sign that it isn't up to the task. You can reset the min-max recording to run another test under View > Clear Min-Max. We advise that you give your GPU a few minutes to return to its standard running temperature in between benchmarks, as it may affect performance otherwise.

4 Scheduled maintenance

While we're talking about temperatures, when was the last time you dusted your GPU? It's always a good idea to clean your system before any benchmarking process, to ensure that you're getting the absolute best performance possible out of your rig. Crack open that case and use an air duster to blast away any build-up on your fans and around your GPU, and clean any removable dust filters your case has. If you're tracking temperatures, you're also going to want to prep by doing a little research first; you'll be able to find the maximum GPU temperature on the manufacturer's website, so you'll know if your card is pushing the heat limit with your benchmarks. You can also check the GPU power draw, but your PSU should have plenty of overhead for stress-testing or even overclocking; this is something to be mindful of only if you have an older or low-power system.

One last bit of housekeeping you may want to do before you sit down to start benchmarking is hopping into the motherboard BIOS. Some BIOS firmware updates can improve GPU performance and stability (albeit only by a small amount), so ensure that your motherboard is up to date. You may need to download a new BIOS update file to a USB drive in order to flash and update the BIOS, but if you're lucky your motherboard will come with the functionality to download and install any updates within the BIOS. While you're there, check that your system's fan curves are set to hit full speed at maximum system load.

The Division 2's built-in benchmark is super easy to run.

Metro Exodus has dank caverns to show off ray-traced illumination.

Fortnite isn't very demanding, so it's a great way to test an older GPU's performance for free.

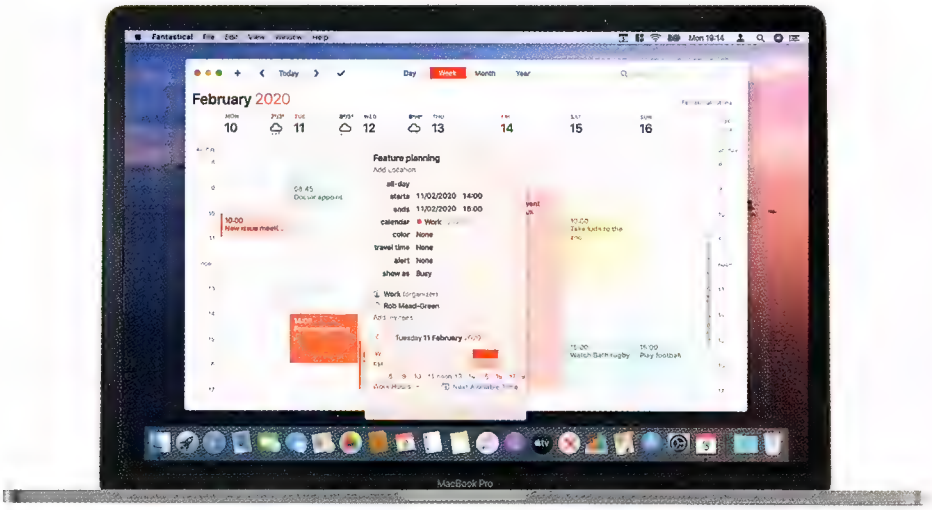
5 Gaming on

As any regular reader of *APC* will know, we use a number of other games when benchmarking systems and GPUs. One of the most useful is *Total War: Warhammer II*. As is the case with many strategy games that demand the generation of hundreds of on-screen units simultaneously, this game is CPU-bound to a certain degree, and as such can give noticeably different scores depending on the processor being used, not just the GPU. It's easy to run: just fire up the game, and under graphics settings you'll find an "advanced" button. Here you'll find the benchmark button, which lets you choose between three different scenes to render. We use the standard "battle" benchmark for our tests.

Another title we use for testing is *The Division 2* from Ubisoft. This benchmark is similarly simple to run – just hop into the settings in-game, set your target specs, and hit "Run Benchmark." As always, we run at 1080p with maximum settings. If you're testing out lower-spec systems, you might want to experiment with medium, low, or minimum settings for these tests. Dropping your resolution to 720p will also boost performance significantly, but the cost of graphical fidelity is a tad high for us.

Other games, such as *Tom Clancy's Ghost Recon Wildlands* and *Assassin's Creed Odyssey*, are ideal tests because they are graphically demanding, and as such will provide a good litmus test for whether your PC can handle modern AAA releases. Both of these have a benchmark that's easily accessible in-game through the graphics settings, along with a useful bonus from Ubisoft: a video memory budget meter that fills up as you turn up the graphics, warning you when you're hitting the limits of what your GPU is capable of.

One game you might have noticed missing from this list is *Rise of the Tomb Raider*, which we often use to test desktops and laptops. While the benchmark in this can be run instantly from the main menu, we don't advise using it, as many of the finer settings can cause hard-to-track frame rate tweaks that don't always correlate to similar performance on different systems. It's a capricious one, for sure. Everything else we've talked about here is fair game, though, so fire up that PC!



MAC

Collaborate with your team

This freshly updated calendar app makes working together easy.

Let's face it, we're all busy enough that we don't want to be wasting precious time micro managing our schedules and wrestling with planning apps. Yet all too often keeping on top of our daily calendars becomes a time-consuming task itself, eating into the hours we really should be spending on more important things.

For years, Fantastical has been a staple of Apple fans everywhere, with Flexibits' organisational apps making serious waves on Mac, iOS and even the Apple Watch. Now, the popular app has been updated to version 3, which brings a new level of organisational nous to the table. Get familiar with its tools and your calendar will never have looked in better shape.

One thing Fantastical particularly excels at is collaboration. Use it to manage your team's workflow and you'll find its natural language support, clever event-planning tools and other sharing features make your work life run that much smoother.

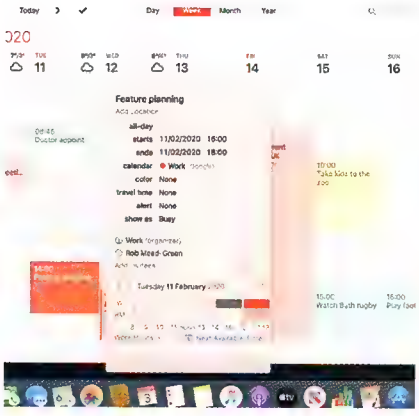
"Use it to manage your team's workflow and you'll find it makes your work life run that much smoother"

IT WILL TAKE
20 minutes

YOU WILL LEARN
How to collaborate with Fantastical 3

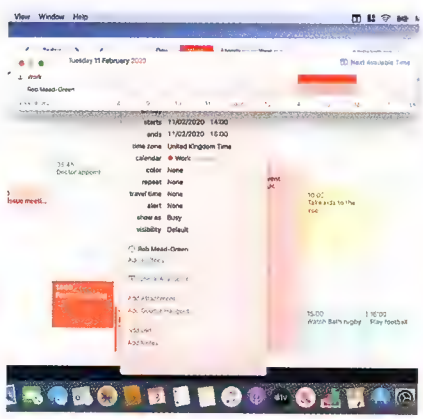
YOU'LL NEED
A Fantastical subscription, macOS 10.13, iOS 13, watchOS 6 or later

HOW TO: Check invitee availability



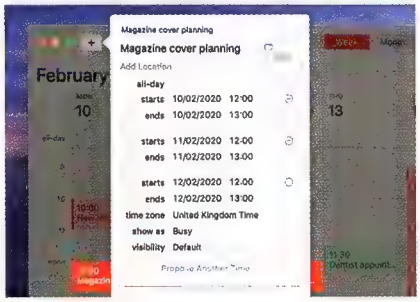
01 ADD AN ATTENDEE
Fantastical can check people's availability for an event and find the best time (although it won't work with iCloud calendars). Double-click an event, click the down arrow, then add a person under Add Invitees.

02 CHECK SCHEDULES
With the attendee added, click Check Availability. You'll see if everyone's schedules are clear; if not, click Next Available Time and Fantastical will suggest an alternative. You can also manually move the time.



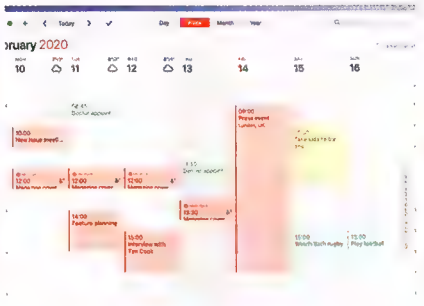
03 GET A CLEARER VIEW
Click the Separate Window button in the availability section to expand the view to a larger window. This is useful if you have a lot of attendees who all have busy schedules and you want to have a clearer look at everyone's availability.

HOW TO: Propose event times to your colleagues



01 MAKE A FEW SUGGESTIONS

Not sure when is best for a meeting? Suggest several times by clicking Propose Another Time in the event creation window. By default, each new event is added a day later, but you can manually change its time to suit.



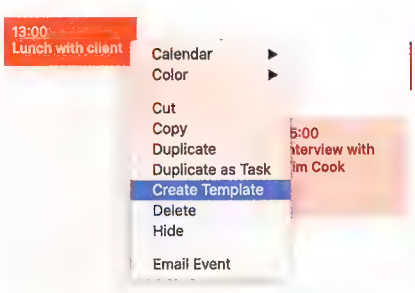
02 WAIT FOR RESPONSES

When you're done, click Add Proposal. Each proposed event is added to your calendar with a Proposed marker. Every person in the event is emailed the list of choices and can choose as many time slots as they like.

03 FINALISE THE DATE

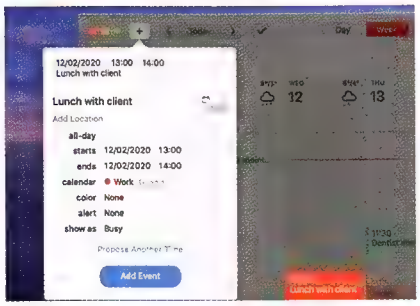
If everyone agrees on a time, it's automatically scheduled in Fantastical and added to the other attendees' calendars, while the remaining proposed times are removed. The agreed-upon event has its Proposed tag removed, too.

HOW TO: Use templates for recurring events.



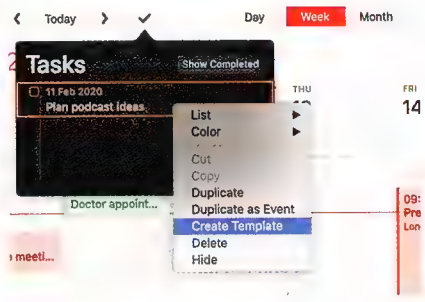
01 CREATE A TEMPLATE

Got a work event that happens often but not on a regular schedule, such as a client meeting or team catch-up? Use templates to speed things up. control-click an event that will be used as a template, then click Create Template.



02 ADD TO YOUR CALENDAR

Click the '+' icon to add a new event – you'll now see the template you created, which is set to the same time of day as the original event. Click it and you can add it to your calendar, adjusting details where necessary.



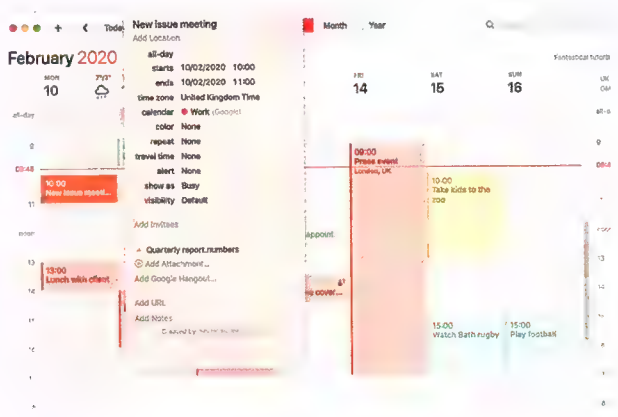
03 SET UP TASK TEMPLATES

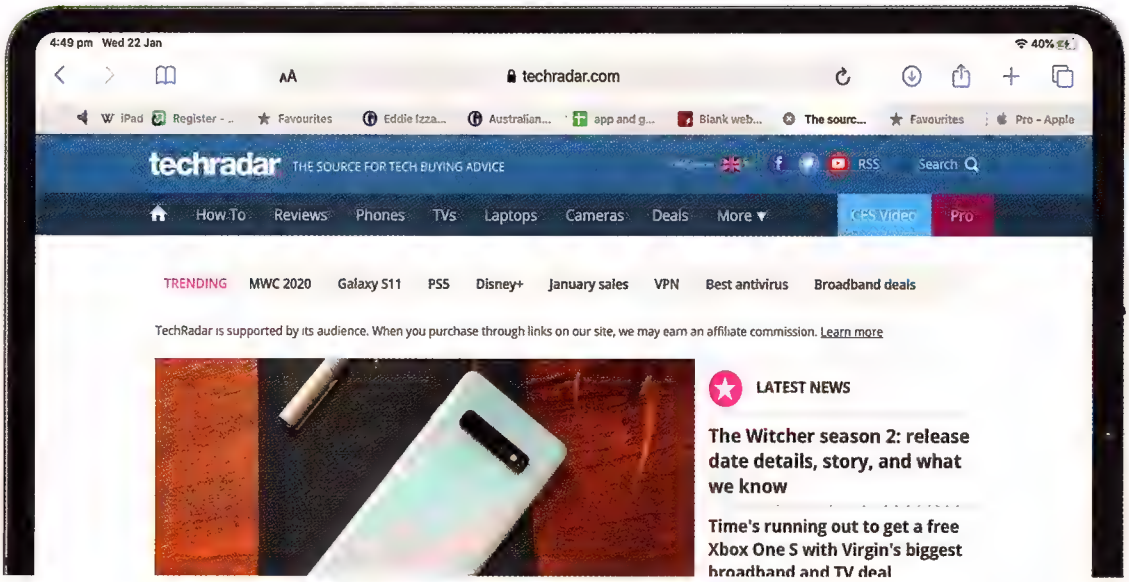
Templates also work for reminders (known as tasks), and the process is very similar – control-click the task (on the calendar or in the task list) and click Create Template. You'll find that template when creating new tasks.

Get even more from Fantastical

Bonus features to boost your workflow

Fantastical is full of other great collaboration features. For instance, while you can assign each calendar its own colour, you can also set colours for certain events within an individual calendar. That's useful if you have a shared work calendar and want to easily differentiate team meetings from your own tasks, say. Just control-click an event and click Color. You can also attach files to events. Double-click an event, click the down arrow to expand it, then click Add Attachment. Everyone on the event will now get a copy of the attachment.

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The Witcher season 2: release date details, story, and what we know
Time's running out to get a free Xbox One S with Virgin's biggest broadband and TV deal

iOS

Master Safari for iPad

A dozen of the best features of Apple's iPad browser refresh.

At a glance, Safari for iPad in iPadOS might not seem that different from Apple's browser in iOS 12, but a lot has changed. The latest version is packed full of new features, a dozen of which we'll explore in the walkthrough. The main underlying change, however, is that Safari for iPad is now effectively a desktop-grade browser.

What this means is that instead of taking the iPhone's version of Safari and blowing it up for iPad, what you get on your tablet is now akin to the browsing experience on a Mac. So when you're using the likes of Google Docs and WordPress, you'll get full-fat versions rather than cut-down mobile equivalents.

Of course, there may be times when you want the mobile version of a site on your iPad – and that's still possible. You simply tap the View menu button (AA), and then Request Mobile Website to do that. For the most part, though, you'll be revelling in your iPad now offering you the grown-up version of the internet.

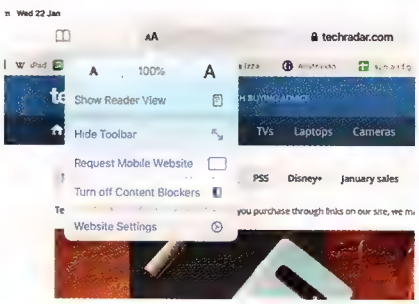
CRAIG GRANNELL

IT WILL TAKE
10 minutes

YOU WILL LEARN
How to access and use more than 12 new Safari features

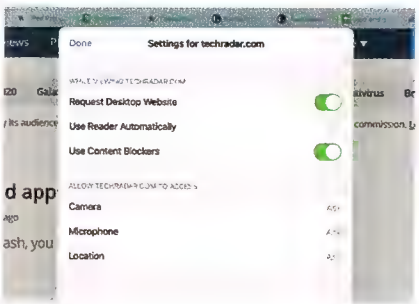
YOU'LL NEED
An iPad running iPadOS, and an internet connection

HOW TO: Schedule Do Not Disturb



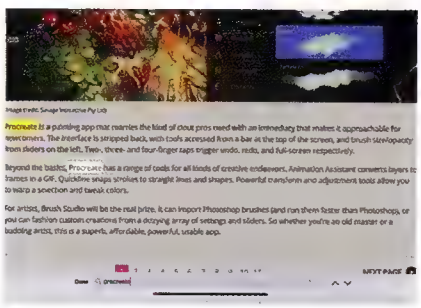
01 ZOOM THE PAGE

Tap the View menu button (AA) and use the two different A buttons to quickly adjust the zoom level for that tab alone (or use command + - and command + +). This level is used for all new tabs for the site until you make a further change.



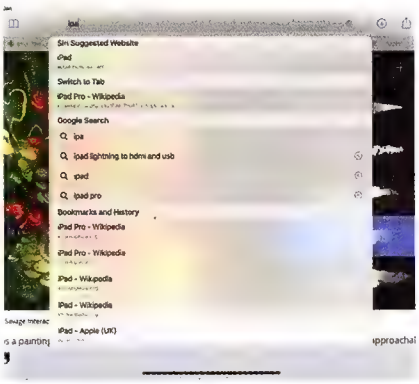
02 DEFINE SETTINGS

Still in the View menu, tap Website Settings. In the pane that appears, you can define the settings and permissions for the current site. Use Settings > Safari or return to this pane to adjust your changes in the future.



03 FIND IN PAGE

Finding terms within a page now works like Safari for Mac. Type a term in the address bar, and tap 'Find "[term]"' (or use command-F if using a keyboard). All matches will be highlighted, so you needn't cycle through them.

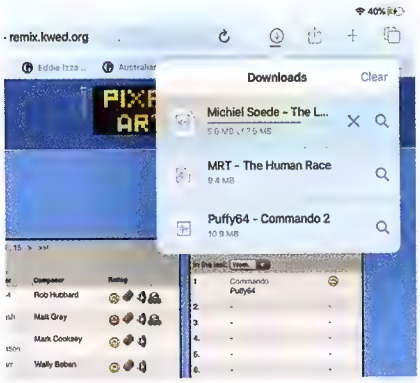


04 FIND IN TABS

Got a million tabs open? Fairly sure one of them contains something you need to get to? Type a search term in the address bar. Switch to Tab will provide a single-tap means of getting at the relevant web page.

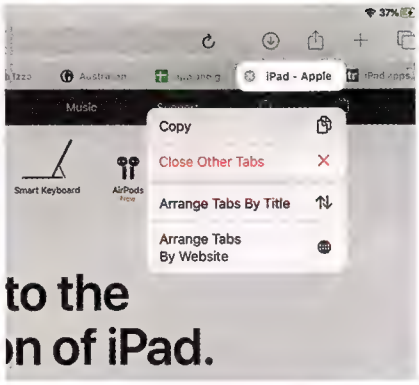
07 AUTO-CLOSE TABS

If over time you tend to end up with dozens of open tabs, and want rid of the clutter, head to Settings > Safari. In the Tabs section, tap Close Tabs, and choose how quickly open tabs should be consigned to history.



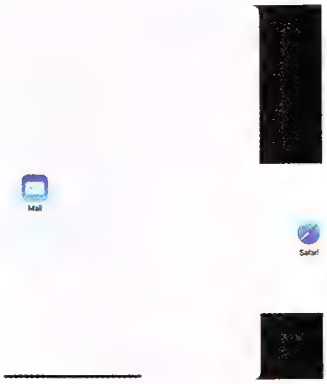
10 DOWNLOAD FILES

Downloads are finally handled in a sensible manner. Tap the downloads button to see what's downloading, and the magnifying glass to view the file in iCloud Drive/Downloads (you can change this location in Settings).



05 ARRANGE TABS

Long-tap a Safari tab in iPadOS and you get access to a tab management menu. Within, you can copy the tab's URL, close other tabs, or opt to arrange your tabs by title or website. Useful for getting a bit more organised.

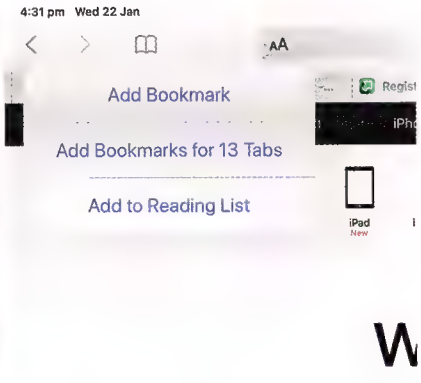


08 DRAG-OPEN LINKS

Tapping a link on iPad has long opened a web page in Safari. But you may now prefer opening a link alongside your existing app in Split View. To do so, tap and hold the link and drag it to the left or right of the screen.

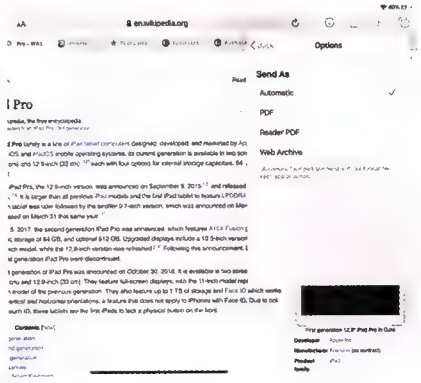
11 USE SHORTCUTS

If you've a physical keyboard connected to your iPad, tap and hold ç. Yep, there are loads of new keyboard shortcuts, again showcasing Apple's desire to make its iPad browser desktop-grade. Commit them all to memory!



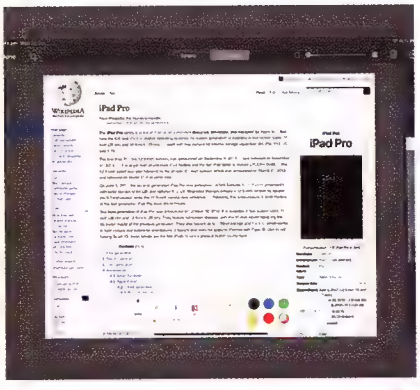
06 SAVE ALL TABS

Previously, long-tapping the bookmark button only let you add the current tab as a bookmark – or send its contents to Reading List. Now, you can also add the set of current open tabs to a user-named bookmarks folder.



09 SMART SHARE

Tap the Share button. You'll see a small Options button underneath the tab's name. Tap that and Safari enables you to define how you'd prefer the page to be sent when sharing it – including as a minimal Reader PDF.



12 GRAB FULL PAGES

It used to be a pain to stitch together multiple screen grabs of lengthy web pages. Now, take a grab, tap it before it slides off-screen, and select Full Page. You'll see the entire web page, ready to send as a PDF.

Playing chess in your terminal

Neil Mohr starts playing the classic strategy game in his terminal.

Known to be over 1,200 years old, chess remains a key test of strategy, mental ability, computational power and is generally a good way of passing the time. If you can represent an eight by eight grid with suitable symbols for the pieces then you can have a game of chess. So why not play chess in your terminal?

Partly this was all kicked off by stumbling across a dreadfully written bespoke open source chess game, which had some ginormous fixed-state machine built from an unfathomable number of nested if statements. So, stuff that for a party.

There's no need to reinvent the chess-shaped wheel. There are a host of accomplished open source chess engines which any front-end that feels the need can plug into. The most common is one called *Stockfish* often described as "the strongest conventional chess engine in the world" and who are we to argue?

Install the chess engine

The first thing you'll want to do is install *Stockfish*. The version in the repository will be fine, and in these Ubuntu 20.04 days that would be the current v11-1 release. A `sudo apt install stockfish` will do the trick.

The terminal front-end we plumped on is called *chs* and is written in Python 3. Ideally, you'd install this with the standard Python package manager *pip*. Install that with `sudo apt install python3-pip` if you don't have it already. Oh and of course you'll need Python3. Ubuntu 18.04+ offers 2 and 3 by default, but run a `sudo apt update && sudo apt -y` upgrade if you don't already have it, to ensure you're all up to date. A quick `python3 -V` should put your mind at ease.

To install *chs* you can now run:

```
$ python3 -m pip install chs
```

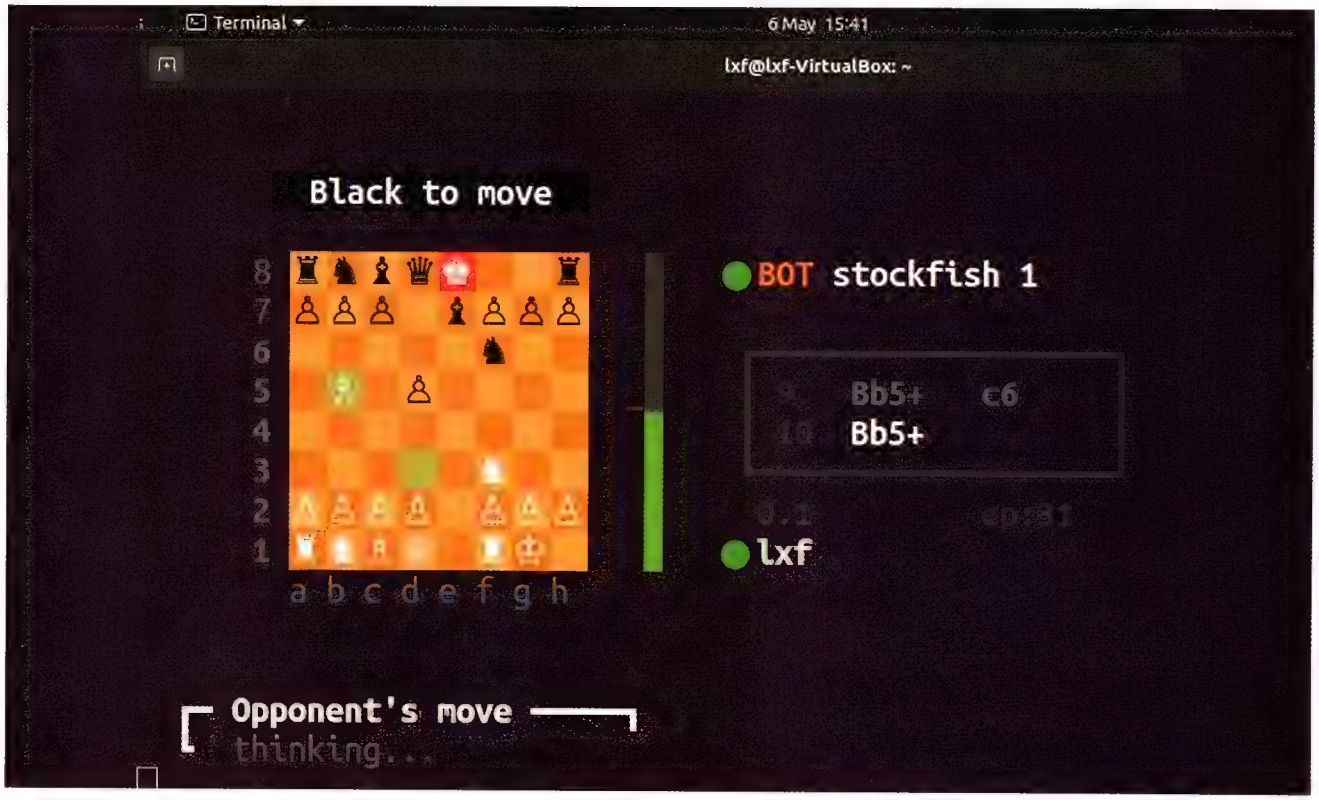
You might notice a WARNING towards the end of the install, suggesting you add the **.local/bin** directory to the $PATH environmental variable, else your terminal is going to be left confused as to where *chs* is. To do this type:

```
$ export PATH="$PATH:$HOME/.local/bin"
```

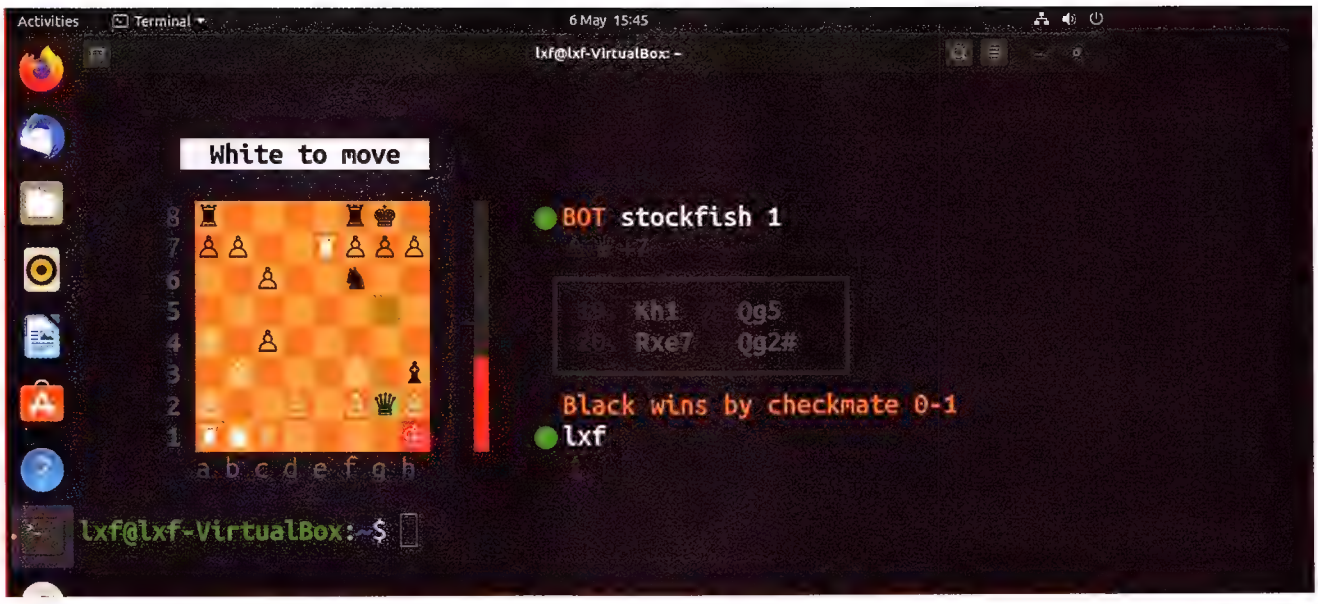
When we now typed `chs` and hit return we got this error: `Uncaught error "FileNotFoundError", exiting the app`. As Jonni spotted this is a known bug in the latest release that hopefully will be fixed by the time you try this. If not then it's an easy fix that requires editing a line in the *Stockfish* config file. Use nano or your favourite text editor to open this file, and replace the phython3.X with the point release you're running – likely 3.6 or 3.8:

```
$ nano -/.local/lib/python3.X/site-packages/chs/engine/stockfish.py
```

The file path to the *Stockfish* executable is incorrect for Linux. Towards the top of the file is an `if elif else` statement. Change the Linux `engine_path` declaration from **stockfish_10_x64_linux** to **/usr/games/stockfish**. Then press Ctr-O and Ctrl-X to save and quit. Type `chs` and you'll find yourself staring at a terminal-based chess board!



Boosting the default font to 25 points results in a much more visible affair, although it doesn't make us play any better.



Game on!

By default chs plays on the easiest Stockfish level (one), but it's more than a match for our puny brains. You can up the level with `chs level=8` that has it on the hardest setting, if you fancy a challenge.

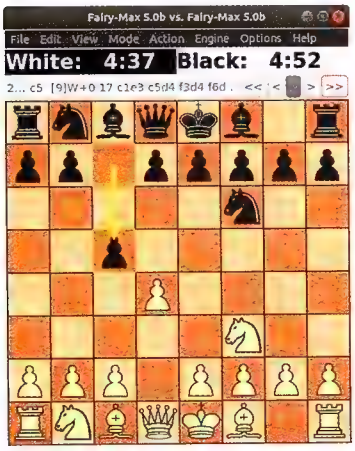
If you're used to playing chess then you might be aware of chess algebraic notation, and this is how you enter moves in chs. Pieces are known by a single letter – Knight (N), Rook (R), Queen (Q), King (K), Bishop (B) – while Pawns are blank. To make a move you simply enter the piece letter and the destination grid coordinate; chs works out the piece you mean. So for example, an opening Pawn e2 to e4 would simply be e4. To move the King's Knight you'd use Nf3. Move the King's Bishop out and with your following move you can castle with O-O (not zeros). You'd castle on the Queen's side with O-O-O.

To capture one of your opponent's pieces you use an 'x' between the piece and the move. So in our imaginary game using the white pawn at e4 to take the d5 pawn you would just write xd5. If it were any other piece you'd start this with the piece's letter. This brings up potential situations where that move could be completed by more than one white pawn – perhaps if there was one also at c4. To eliminate conflicts you'd include the row letter (or file number, whichever removes the conflict) to the start, so exd5, for this example.

We deliberately permitted the computer to checkmate us, just so we could quickly get this screengrab.

A couple of special commands let you cheat, erm, we mean revise your game. The `back` command takes back your last move(s), as far back as you like, while the `hint` command gives you a bit of advice from the *Stockfish* engine. That should be enough to get you up and running – there are some further details such as Queening or En Passant, but you'll work it out when you need to!

The default board is annoyingly small, and the default mono typeface in Ubuntu won't scale the ISO chess piece images with the terminal type. If you want a larger board you have two options. Either select Terminal Menu>Preferences>Profile and switch on Custom font and use, as an example, the Ubuntu Mono Regular type, which scales to larger point sizes. Alternatively, use the Menu>Scale option to simply magnify everything.



With *GNU Chess* you get the best of both worlds: the choice of terminal gaming or a fancy GUI in which to play your Queen's Pawn Game.

GNU Chess

You'd be right to think that we've missed an obvious chess playing option and that's the Free Software Foundation's *GNU Chess*. This is another terminal-based game, but not as visually pleasing as chs. If this is a problem then there's a GUI that plugs into the *GNU Chess* engine and you can pick up things from there. It has the advantage of being GPLv3 licenced and is a middle-aged 36 years old.

You'll find out all about *GNU Chess* over at **www.gnu.org/software/chess**. To get up and running in a terminal use `sudo apt install gnuchess` and start it with `gnuchess`. It uses the same standard algebraic moves as we've discussed and will present a board after each move. To get the GUI in place type `sudo apt install xboard` and use `xboard` to fire it up.

Alternatively, the *Gnome Chess* game you'll find in the Software Centre of most distros is based on the same *GNU Chess* engine, which as it turns out has a relatively strong rating of 2,813 Elo points – that's better than the playing abilities of a chess Grandmaster!

Route traffic between networks using a Pi

Sean Conway provides the network theory along with all the configuration details to turn a Pi into a router, keeping you busy during lockdown.

A deep-dive into Pi networking solutions resulted in this tutorial. The goal was to uncover a Pi configuration that would enable the routing of network traffic from a wired network to a wireless network. The aim is to build a network router using a Raspberry Pi. The Pi router would be responsible for moving network traffic between a wired Ethernet network and a wireless Wi-Fi network.

The Ethernet network is a local area network (LAN) with hosts (PCs) connected. The Wi-Fi connects to a larger network via a network access point (AP). A router is required to move traffic between the two networks. We're going to build that routing device while exploring the network theory. Strap in, people!

The Pi router will use a number of networking services. The LAN side of the Pi will require DHCP services to provide host's private IP addresses when they connect. The Wi-Fi side of the Pi will need to be configured to connect to an AP in the other network. Because the wired and wireless networks are separate, the Pi needs to route traffic between these two networks interfaces. The network address translation (NAT) service will be used to route the LAN network traffic back and forth to the Wi-Fi network.

Internet protocol (IP) basics

Before examining the Pi configuration, let's review some of the networking theory involved. We'll start by introducing some IP address concepts. An IP address is the convention used to identify (address) devices in a network that uses the transport control protocol/internet protocol (TCP/IP). The IP address provides the same function for network devices that your postal address provides for delivering a letter or parcel. Each device on a network must have a unique IP address and each network will have a unique network number, if the network traffic is to be transported correctly.

The TCP/IPv4 standard specifies that each device in a network be identified by a unique 32-bit binary number. Computers start counting from zero (0), and 0-31 bits totals 32 bits. The 32-bit binary number is broken into four eight-bits groups called octets. To overcome the difficulty of trying to use a binary address for an address, the IP address uses integer numbers zero to nine, in a format called dotted decimal notation.

The 32 bits are divided into two components: network ID bits and a host ID bits. The subnet mask address masks out the bits that represent the network ID part of the binary number. The remaining bits represent the host ID.

Key devices on a network

Networking devices are designed to operate on the Protocol Data Unit (PDU) found at a specific layer of the OSI network model. IP addressing is the address format for PDUs found at the network layer. Routers look at the IP address to determine where to route PDUs. A router that's responsible for getting PDUs in and out of the local network is called the default gateway.

Routers are only interested in finding networks, not the hosts in the networks. When a router receives a PDU the router uses the subnet mask to determine what network the PDU is destined for. The combination of IP address and the subnet mask that identifies the network portion of the IP address enables the network traffic to be routed correctly across different networks.

A router finds other networks by talking to other routers. Routers talk to each other using a routing protocol. Using this protocol the routers exchange details about the networks they know about. The routes (the path to take from source to destination) are stored in a routing table. When a router receives the PDU it uses the routing tables to determine the best route to use for delivering the PDU to the destination.

There are two addressing mechanisms in play to move a PDU's from source to destination. We've already introduced IP addressing. The second is media access control (MAC) addressing. In some circles, MAC is referred to as physical addressing because it can physically be found on network interfaces. IP addressing operates at the network layer of

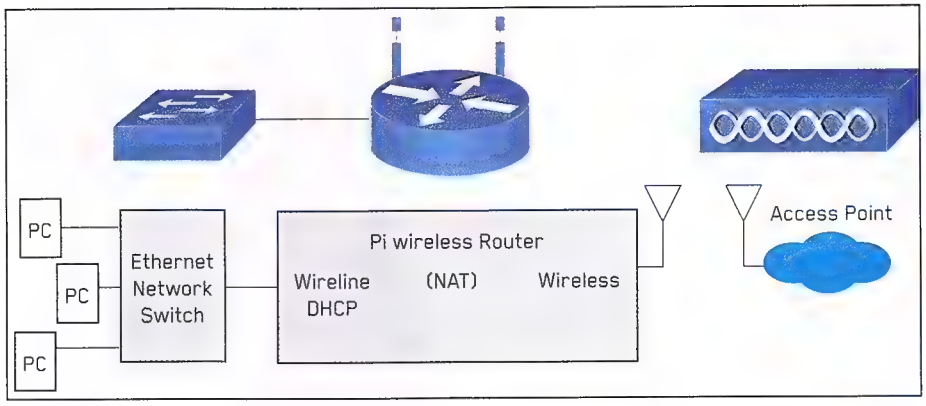
Adding bit zero results in 32 bits – this is in no way confusing.

Four octets	W								X								Y								Z							
4X8bits	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
32 bits	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary address	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1	1	0	1	1	0
Dotted decimal notation	192				•	168			•	200			•	54																		

Binary address	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1	1	0	1	1	0
Dotted decimal notation	192				•	168			•	200			•	54																		
Binary mask	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0
Subnet mask	255				•	255			•	255			•	0																		
	Network ID																								Host ID							

the OSI model. MAC addressing operates at the data-link layer.

The diagram shows only the addressing headers associated with a PDU. The goal is to move a PDU from Host_X (green IP address) on one network to Host_Y (blue IP address) in another network. Two routers are in place between the networks. They've been exchanging their routing tables long before our PDUs have arrived. The routers know about each other and how to move network traffic through the information in the routing tables. The different colours are used to define the source and destination addressing in the different PDU layer found in the PDU header as they move across the networks.



Network symbols in a block diagram of the project.

The physical address (MAC) of the PDU changes as the data unit moves through routers, but the network PDU IP address remains the same. The network interface cards in each unit are working the physical address to move the PDU. The IP address remains the same to ensure the PDU is delivered from the source to the destination.

The routers are only examining the IP address and consulting their routing tables to see what's the next action the PDU needs to take to get it one network closer to arrive at the host's network.

The PDU that contains the physical address are called a frame. The PDU that contain the IP address are called a packet. It's not uncommon for documentation to refer to all PDUs as packets. This can add confusion. Frames are moved across a network. There are different kinds of frames depending on the technology used in the physical network. Inside the frames are packets that the routers examine to route.

Managing network traffic

Dynamic host configuration protocol (DHCP) is a service that automates the management of IP addressing. DHCP distributes IP addresses and other IP details, like the default gateway IP address, to hosts on a network. Remember that the default gateway is the router that hosts use to get out of their network. The majority of local area networks (LAN) today rely on DHCP to provide IP configuration details to hosts.

PDUs for delivery are tagged with a source and destination IP addresses, packaged in a PDU with MAC addresses and then transmitted over the network. Routers along the network path from source to destination are responsible for checking the destination address of the PDU and performing routing to ensure the data is delivered to the correct final destination. At the destination address the data is removed from the packaging and delivered.

QUICK TIP
Documentation on setting up Wi-Fi can be found at **www.raspberrypi.org/documentation/configuration/wireless/wireless-cli.md**

A DHCP server assigns unique IP addresses to hosts (i.e. devices) that make requests. DHCP provides the IP address of the default-gateway for the network and the IP address for the DNS servers that will take responsibility for changing human readable addresses into IP addresses that are used to move the PDU.

To enable network PDU traffic to move between network interfaces in our Pi, forwarding would need to be enabled. Having a device span multiple networks is not a good idea because it creates a network security concern. If the device becomes compromised by bad guys, then they'll have access to those networks.

Security on a network

Enabling forwarding on a device that spans networks requires a special router called a firewall. A firewall placed between the networks provides some isolation, and is a service that uses a set of defined rules to determine if traffic (PDUs) is allowed to pass. A default gateway on a network may also be a firewall. Since this device manages network traffic in and out of the network, it can use the rules to filter undesirable traffic.

In this Pi project we're using the firewall service called iptables. This is a firewall utility built for Linux operating systems. iptables comes pre-installed with Raspbian O/S. Remember, PDUs are moving through networks carrying user data. iptables is a command-line firewall service that uses policy chains containing rules to filter incoming and outgoing data PDUs.

We'll use the command line to configure iptables. There are GUI tools that can be used to configure iptables, but Raspbian doesn't support a GUI so this tutorial will provide a few of the commands needed to establish a configuration for the Pi project. You need to be

Seasonic's CORE GX series includes a fully-modularised cabling setup.

Network Address Translation

Network address translation remaps one IP address to another IP address by changing the network IP address information in the header of the PDU. The technique is used extensively to optimise the use of public address space. With the number of public IP addresses being used up, NAT enabled multiple private IP addresses to be remapped to one public IP addresses.

In our project we're using NAT to change IP addresses from the wired network to the wireless network.

The preferred method would be to have routers in each network find and route PDUs between their respective networks, but routers have a cost exponentially higher than the cost of a Pi. Furthermore, router placement and configurations can be complex. If the routers aren't configured correctly, they can cause any amount of grief and aggravations in a network.

The upshot is that just because you can use a Pi to accomplish a task, doesn't necessarily mean it's the best solution for the task!

careful issuing iptables commands, especially if you're accessing the Pi over a network SSH connection. A wrong command can lock out your session until you can physically access the Pi and remove the errant rule.

When a network connection tries to establish itself on the Pi interface, iptables looks for a chain rule in its list that matches the request. If iptables doesn't find a rule, it resorts to the default action defined for the chain. For security reasons the default should be REJECT, because there's no rule to govern the condition.

In addition to iptables providing filtering rules, it can also provide network address translation (NAT). The NAT rule defined in iptables enables all IP addresses from the PDUs on the one network to be replaced with the single IP address used in the other network.

In this project all the host's PDUs that have DHCP assigned IP addresses will be translated into the one IP addresses that's been assigned to the Wi-Fi interface in the second network. The iptables service will maintain a state table to translate the returning PDUs back to the correct DHCP IP address for their destination.

QUICK TIP
Search RFC 2460 on **rfc-editor.org/search/rfc_search.php** for IPv6 details.

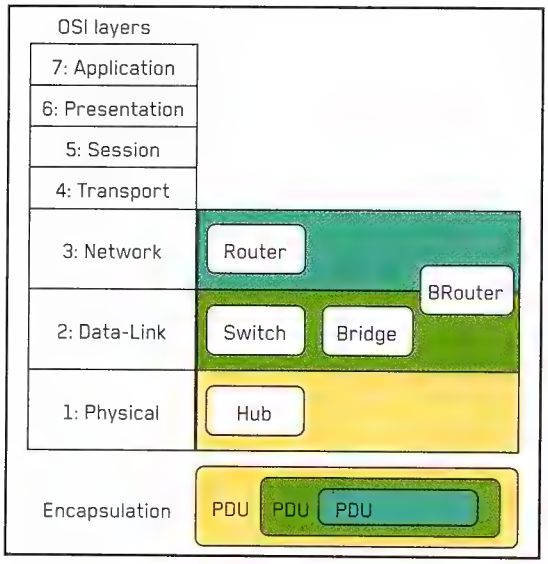
IP Address Classes

32-bit IPv4 addressing is divided into classes:
Class A (default Subnet Mask 255.0.0.0)
1.x.y.z to 126.x.y.z
1.0.0.1 to 126.255.255.254 valid range of host IDs
0111 1111 (127 decimal) reserved for testing
10.0.0.0 to 10.255.255.255 reserved private networks RFC1918
128 networks 16,777,214 usable host per network
Class B (default Subnet Mask 255.255.0.0)
128.0.y.z to 191.255.y.z
128.0.0.1 to 191.255.255.254 valid range of host IDs
172.16.0.0 to 172.31.255.255 reserved for private networks RFC1918
16,384 networks 65,534 usable hosts per network
Class C (default Subnet Mask 255.255.255.0)
192.0.0.z to 223.255.255.z
192.0.0.1 to 223.255.255.254 valid range of host IDs
192.168.0.0 to 192.168.255.255 reserved for private networks RFC1918
2,097,152 networks 254 usable hosts per network
Don't get comfortable with 32-bit IPv4 addressing. 128-bit IPv6 addressing is already changing the landscape. IPv6 is designed to accommodate the IPv4 through the transition.

Configuring the Pi

For this project we're using a Pi 3B+ with Raspbian Buster Lite, Version: February 2020. The Pi's wired connector is connected to an Ethernet network using a CAT5 cable. We're assuming that you have sufficient knowledge to establish an operating system on the Pi and can configure the Pi to support an SSH connection from an external host. Before starting the configuration, ensure all software updates to the Raspbian operating system have been completed.

Devices on OSI framework with PDU encapsulation thrown in for some colour.



Let's get the network interfaces active. The first step is to establish a static IP address on the Pi Ethernet interface. Using your usual text editor amend the /etc/dhcpcd.conf file to reflect the following:

```
interface eth0
static ip_address=192.168.200.1/24
static routers=192.168.200.0
```

The file will have information similar to what's shown above, but will be commented out with an octothorp, another term for the hash sign (#). The file can be changed to support our configuration by adding the lines to the end of the file or by removing the octothorp in front of the existing lines and correcting the text to reflect what's shown. The entries are assigning an IP address to the interface named eth0, defining the network bits by providing the subnet mask of /24.

Creating the file /etc/wpa_supplicant.conf with the Wi-Fi network configuration parameters will establish a Wi-Fi connection. One way to accomplish this is from the command line using a text editor. An easier approach would be to use the Raspbian configuration tool raspi-config to establish a Wi-Fi network. You'll need to know the Wi-Fi connection credentials, SSID and password to complete this task.

In our example the SSID for the Wi-Fi was 'Guest-Network' with a password of 'Pi 3B+wifi'.

A reboot should restore the Pi with interfaces configured with the IP address. Confirm this from the command line using the ip a command. The eth0 interface will have the IP address and the Wi-Fi should be connected, providing the IP address from that network.

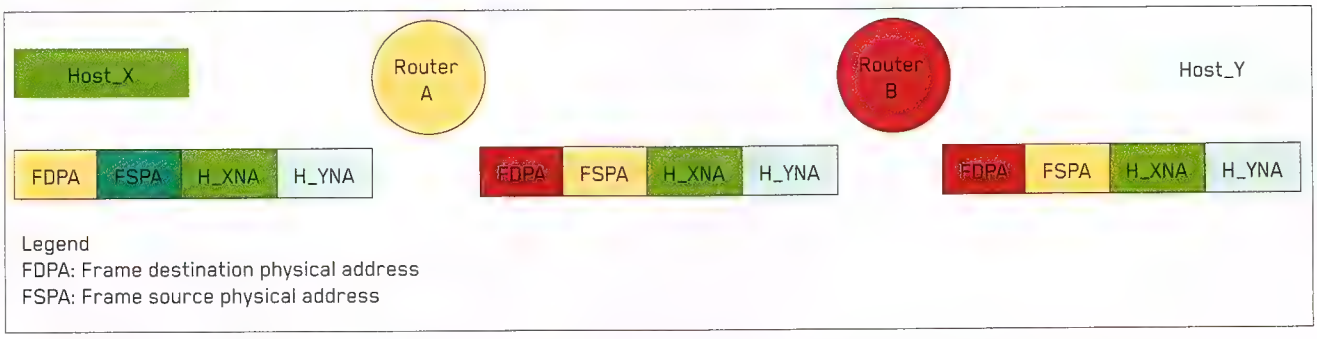
The next step is to establish DHCP services. This version of Raspbian utilises the dnsmasq package to support DHCP. The package provides both a DHCP server and a local DNS server. Remember that DHCP is looking after the IP assignments to hosts and DNS is carrying out URL address translation. The dnsmasq package replaces two packages, isc-dhcp-server and bind9, that were previously used to provide the services.

From the Pi CLI, issue the commands to install the dnsmasq package. In addition we're going to move the default configuration file for this service to preserve its contents before we customise it for our needs.

```
sudo apt install dnsmasq
sudo mv /etc/dnsmasq.conf /etc/dnsmasq.conf.orig
```

Use your usual text editor create the file /etc/dnsmasq.conf containing the following lines:

```
interface=eth0       # Use interface eth0
listen-address=192.168.200.1 # Specify the address to listen on
```




```
bind-interfaces      # Bind to the interface
server=8.8.8.8       # Use Google DNS
domain-needed        # Don't forward short names
bogus-priv           # Drop the non-routed address spaces.
dhcp-range=192.168.200.50,192.168.200.150,12h # IP range and lease time
```

The original file ownership and permissions for the configuration file need to be applied when the new file is established. Let's take a quick look at the contents of the file. The listening interface line is the static IP address we assigned earlier. Looks like we are using Google DNS from the server IP. The range parameter defines what IP addresses' range to use when giving out IP addresses to hosts that make DHCP requests. A reboot of the Pi will bring the Pi DHCP server online.

The original dnsmasq file that was preserved in /etc/dnsmasq.conf.orig is well documented. It's an ideal reference for finding out more information about the parameters available in the configuration file.

This device has the potential of creating problems in a network, if the Pi Ethernet interface is connected to a production network. The Pi DHCP server will answer DHCP requests. If the network already has a DHCP server, the Pi's server may cause confusion in the network. For testing, it's recommended that the Pi Ethernet interface be connected to an isolated network switch similar to the configuration shown in the block diagram at the start of the article.

We can confirm the dnsmasq service is operational and run a test of the configuration file by executing the following commands from the command line on the Pi:

```
journalctl -u dnsmasq.service
dnsmasq --test
```

The commands confirm the service is active and does a check of the configuration file to confirm it has correct syntax.

Stay calm and let the router move the traffic to the nearest exit.

The Pi DHCP server can be operationally tested by connecting a PC that's configured to request an IP address from DHCP to the network switch connected to the Pi. The Pi DHCP server keeps track of host assignments in the file /var/lib/misc/dnsmasq.leases. A cat of the file during testing produced the line:

```
1581347125 68:5b:35:83:c0:f6 192.168.200.54 sconway-MacBookPro 01:68:5b:35:83:c0:f6
```

An IP address 192.168.200.54 was assigned to hostname sconway-MacBookPro with a MAC address 01:68:5b:35:83:c0:f6.

The next change enables the Pi to route between the wired ethernet interface and the Wi-Fi interface. Using a text editor modify the file /etc/sysctl.conf by removing the # from the line net.ipv4.ip_forward=1 . By default, forwarding between interfaces is turned off. Removing the # enables forwarding.

The iptables service is running by default on the Raspbian OS. The three rule tables or chains for iptables can be examined by issuing the following command from the Pi CLI:

```
sudo iptables -L
```

Notice the three (policy ACCEPT) listings, one for each chain. This indicates iptables is accepting all network traffic into, out of or between the interfaces on the Pi. No rules are in place to manage traffic.

The syntax for the configuration file for iptables is exacting. If we had the time we could use a text editor to produce a rules file containing the options to configure iptables. A much easier method is to just send the needed rules to iptables and have iptables generate its own configuration file containing the rules.

From the Pi CLI issue the following commands to establish the iptables rules and then save the configuration to a rules file that can be restored later. Recall the purpose of using iptables is to establish NAT (network address translation) so PDUs can move from the wired side of the Pi and assume the Wi-Fi IP address on the network. Notice the rules reference the two Pi network interfaces:

```
sudo iptables -t nat -A POSTROUTING -o wlan0 -j MASQUERADE
sudo iptables -A FORWARD -i wlan0 -o eth0 -m state --state RELATED,ESTABLISHED -j ACCEPT
sudo iptables -A FORWARD -i eth0 -o wlan0 -j ACCEPT
sudo sh -c "iptables-save → /etc/iptables.ipv4.nat"
```

As rules are entered they take effect immediately. Using the iptables -L command will show some of the changes to the chains that have taken place.

The generated iptables rules file needs to be loaded when the Pi starts up. This can be done by adding a command call to the /etc/rc.local file. Using your text editor add the text shown in the line, above the line in the file containing exit 0 that's at the bottom of the file:

```
# restore iptables configuration to establishing nat
sudo iptables-restore ← /etc/iptables.ipv4.nat
```

Here ends a whole lot of networking theory along with a Pi configuration that enables hosts from an Ethernet network to route their PDUs to a Wi-Fi network. The topic is complex, but we tried to consistently apply terminology to avoid confusion. ■

QUICK TIP

To identify the URL, find the IP address: **https://whatismyipaddress.com/hostname-ip**

PSU201: Going for Gold

Darren Yates continues his short series on PC power supply units this month, looking at power efficiency and the less obvious differences between Gold, Silver and Bronze.

Over the last couple of months, we've covered simple PSU ratings and how you'd choose between anchored, semi-modular and modular designs. Now that we've considered the basics, we're moving into 'PSU201' and some deeper concepts. Buying a PSU on watts alone is like buying a car just by its colour, except with PSUs, colours actually do mean something. This month, we talk PSU power efficiency – we investigate those 'Gold', 'Silver' and 'Bronze' ratings, what they mean and why they matter to your hip pocket.

Power efficiency

Back in PSU101, we said a PSU's role is to convert the mains outlet AC voltage into a series of low-voltage DC sources or 'rails' to power your PC components. Now that we're in PSU201, we can flesh that idea out and now say there is a bit more to it.

In simple terms, the AC-DC conversion process is somewhat 'leaky', meaning it is not 100%-perfectly efficient. Some of the energy dissipates as heat, which is neither useful nor helpful. However, while all PSUs do lose some energy as heat, the better ones lose less, particularly when the PSU is pushed hard (what we call 'loaded down').

Efficiency is measured as a percentage and is the 'load' power the PSU sends to your PC divided by the input power the PSU needs to make that load power, multiplied by 100. For example, if your PC requires 200-watts, but the PSU needs 250-watts input, its efficiency is 200 / 250 = 0.8 x 100 = 80%.

What you also need to know is that efficiency varies, depending on this electrical 'load' the PSU has to power (ie. your PC). What's more, efficiency tends to drop at both ends of the load spectrum – when you're using only a bit of the PSU's rated power output and when you're flogging the daylights out of it. As a result, the better PSUs maintain a higher efficiency with heavier loads (when it's tough to do so) and lighter loads (when idle power is more noticeable).

Why does it matter?

Efficiency matters for a simple reason – money. When it comes to your power bill, you pay for the AC input power to the PSU, not the DC output power to your PC. So, the less efficient your PSU is, the more AC input power it needs and the more you pay for it.

A voluntary program called '80 PLUS' was created to make it easier to understand which PSUs deliver greater efficiency and it has several steps or grades from 'basic' to 'Bronze', 'Silver', 'Gold', 'Platinum' and 'Titanium', depending on the efficiency obtained at 10%, 20%, 50% and 100% of the PSU's rated output power. Take a look at Table 1.

In a nut-shell, the higher up the grades you go, the greater the minimum efficiency level guaranteed and for more of the load spectrum it delivers that minimum.

However, notice a couple of things. First, the highest efficiency percentage guaranteed on each grade is always at 50% of the rated output power. For example, 'bronze' guarantees 85% minimum across the board from 20% to 100% load, but 88% efficiency at 50% load. Similarly, 'gold' is 89% minimum across the range, but 92% efficiency at 50% load. Take this as another reason to consider buying a PSU nominally rated at double the output power your PC requires – you get maximum efficiency. For example, building a PC needing 230-watts, you buy 450. Putting together a 360-watt gaming rig, you buy 700. Not only does this get you maximum efficiency, but, in my personal experience, better

The 650-watt Seasonic CORE GC-650 PSU is another 80 PLUS Gold-rated.

	PERCENTAGE OF RATED LOAD			
	10%	20%	50%	100%
80 PLUS		82	85	82
80 PLUS BRONZE		85	88	85
80 PLUS SILVER		87	90	87
80 PLUS GOLD		90	92	89
80 PLUS PLATINUM		92	94	90
80 PLUS TITANIUM	90	94	96	94

Table 1: The six 80 PLUS grades relate efficiency to load power.

reliability. Electronic components in general don't like being thrashed, so the more breathing space you can give them (and reducing the load percentage does that), the longer they tend to last.

The second point to note is that only 'Titanium' grade PSUs guarantee a minimum efficiency level at 10% load. This basically says most PSUs don't get out of bed for less than 20% of maximum output power.

To put it another way, this is why you don't buy a 1200-watt PSU for a dual-core Pentium box to read your email. PSUs struggle for efficiency at low-percentage output power, so if you have a PC that presents a 100-watt load to a PSU, that's just 8.5% of a 1200-watt PSU's capacity. No-one's going to guarantee you any efficiency level at 8.5%! However, 100-watts is 22% of a 450-watt PSU's capacity, where you will get a minimum efficiency guarantee (remember, all 80 Plus efficiency guarantees cover 20% loading).

So, choosing a PSU is a balancing act between buying sufficient headroom, but not too much that the PSU just loafs along. To get decent efficiency, the PSU has got to have something to do – and that's why buying a PSU capable of delivering twice the power you need covers most of the bases.

Basic vs Platinum

Getting back to the different grades, those differences can add up. For example, take a 400-watt PC as load and compare the actual input power to an 800-watt 80 PLUS 'basic' PSU and an 800-watt 80 PLUS 'Titanium' PSU, both running at 50% loading.

The 'basic' PSU needs 400 / 85% = 470-watts input, but the Titanium, only 400 / 96% = 416-watts. That's a difference of about 55-watts or four 14-watt LED globes. If the PSU runs 24/7-continuously, the difference amounts to just over 1.3-kilowatt-hours (1.32kWh) per day or 480kWh for the year. At an average 32-cents-per-kWh electricity rate, that's 480 x 0.32 = $154 per year – every year – added to your power bill just to run the 'basic' PSU instead of the 'Platinum' on the same load. Sure, most PCs don't normally run at 400-watts day-in-day-out unless you're crypto-mining, but even at just 200-watts, the difference is still around $80 a year, which no doubt you could spend differently.

Now of course, a Titanium PSU will cost roughly three-times the price of an 80 PLUS 'basic' PSU at the same power rating, so it'll take a couple of years to get in front, but that is the extreme case. Do the sums for 'basic' vs 'GOLD' and the cost difference and break-even time should be less.

Corsair's 750-watt RM750x PSU is 80 PLUS Gold-rated.

Efficiency doesn't guarantee quality

Improving efficiency has other benefits, including reducing heat and noise. However, it doesn't guarantee build quality, so you still need to buy a good brand first. Otherwise, if you're gaming – especially if you're crypto-mining – take power efficiency seriously. Next time, we look at the concept of 'power factor' and sort out a f ew ideas.

EVGA's SuperNova 850 is an 850-watt 80 Plus Platinum-rated PSU.

DOWNTIME

DO YOU WANT TO PLAY A GAME?

FIFA 21 for PC will be a port of the PS4 and Xbox One game

THE BIG NEXT-GEN FEATURES WILL BE STUCK ON PS5 AND XBOX SERIES X.

Electronic Arts announced *FIFA 21* at its EA Play showcase in mid-June, and it looked impressive: vague improvements such as improved "player humanisation" and a "deferred lighting system" seemed to suggest that the glacially iterative soccer game might receive a dramatic facelift. But if that proves to be true, PC owners will not benefit from the "next-gen" visual upgrades in the same way owners of the PlayStation 5 and Xbox Series X will.

Following the announcement an FAQ appeared for the game, which seemed to confirm that PC players will be stuck with the last-gen version of FIFA. In a statement sent to *APC*, EA confirmed it directly. "The PC version will be the same experience as the Xbox One and PS4 versions of the game," the statement said, "so technically yes, it won't be optimised with any features specific to Xbox Series X or PS5."

Watch out for Sims peeing fire in the latest *Sims 4* update

The Sims 4 just got a brand new update and expansion pack that's all about going green, but more importantly, Sims are peeing fire now. The terrifying bug was introduced with a sizable new patch preceding the *Eco Lifestyle* DLC, available now. It's not uncommon for updates to arrive hiding some unpalatable dysfunction, but this just might take the cake.

GAMING NEWS

The Order 1886 and Lone Echo studio acquired by Oculus

Ready at Dawn is currently working on *Lone Echo 2*.

The creator of PlayStation 4 exclusive *The Order 1886* and Oculus Rift VR series *Lone Echo* has been acquired by Facebook. Vice president of AR/VR content at Facebook, Mike Verdu, shared the news today in a blog post, where he confirmed that the studio will continue development on *Lone Echo 2*.

The acquisition follows Facebook's 2019 purchase of *Beat Saber* studio Beat Games. Like Beat Games, Ready at Dawn staff will continue to work from their current offices situated in California and Oregon, but all will be absorbed into Oculus Studios.

"The tight-knit community at the studio and their focus, in turn, on cultivating passionately engaged gaming communities are aspects of the company we admire and intend to maintain," Verdu wrote.

Ready at Dawn was founded in 2003 and cut its teeth developing games for the PSP. Its first major console game was the 2015 PS4 exclusive *The Order: 1886*. Since 2017, the studio's predominant focus has been on VR, in particular the *Lone Echo* series and all of its offshoots. Oculus Studios published *Lone Echo*, and its standalone multiplayer component, *Echo Arena*, has been bundled with Oculus Rift headsets.

Cyberpunk 2077 skips September, will ship in November instead

CD Projekt Red still has some work to do.

The most anticipated game of the year is still a while off, with *Cyberpunk 2077* releasing on November 19 instead of its previous September date. The game was originally scheduled to launch in May, but *The Witcher 3* studio CD Projekt RED seems determined to ship a game that will prove just as awe-striking as its last.

"The quests, the cutscenes, the skill and items; all the adventures Night City has to offer – it's all there," the studio wrote. "But with such an abundance of content and complex systems interweaving with each other, we need to properly go through everything, balance game mechanics and fix a lot of bugs. A huge world means a huge number of things to iron out and we will spend the additional time doing exactly that."

Destiny 2 on PS5 and Xbox Series X will be a free cross-gen upgrade

Intergenerational cross-play confirmed.

The latest *Destiny 2* expansion, *Beyond Light*, will support free cross-gen upgrades for PS5 and Xbox Series X players, alongside all expansions for the game.

Announced as part of a recent *Destiny 2* reveal stream, players who buy *Beyond Light* on PS4 and Xbox One can expect to upgrade their copies of the expansion for free when they move onto next-gen consoles. Game director Mark Noseworthy confirmed that all content you own, past and present, will also be cross-gen.

Destiny 2: Beyond Light will be part of the Xbox Smart Delivery service, which ensures that your purchases will play best on whatever platform you're running them on. Bungie also confirmed that PS4 purchases will upgrade to PS5 for free.

The studio will share more *Destiny 2* next-gen news over the course of the summer, so it seems likely we'll learn more about its cross-generational plans between now and the launch of the PS5 and Xbox Series X. Oh, and these consoles will run *Destiny 2* at 60 frames per second and 4K resolution.

Call of Duty: Modern Warfare and *Warzone* matches now begin with Infinity Ward's Black Lives Matter statement

NBA 2K20 also raising awareness of movement in-game.

Call of Duty: Modern Warfare has received a new update from Infinity Ward, with an in-game statement in support of the Black Lives Matter protests now appearing at the start of every multiplayer match, including those in *Call of Duty: Warzone*.

"The systemic inequalities our community experiences are once again centre stage. Call of Duty and Infinity Ward stand for equality and inclusion." reads the statement. "We stand against the racism and injustice our Black community endures. Until change happens and Black Lives Matter, we will never truly be the community we strive to be." The update arrives after Activision announced it would be delaying both *Call of Duty: Modern Warfare Season 4* and *Call of Duty: Mobile Season 7*, explaining that "now is not the time" to focus on distractions as protests continue across the globe.

Infinity Ward also revealed more yesterday about the steps it would be taking to address and crack down on the racist usernames that are found amongst its playerbase, admitting that it "needs to do more" to tackle "repeat offenders".

Microsoft has shut down Mixer

A YEAR AFTER SPENDING BIG ON TALENT, THE TWITCH COMPETITOR IS NO MORE.

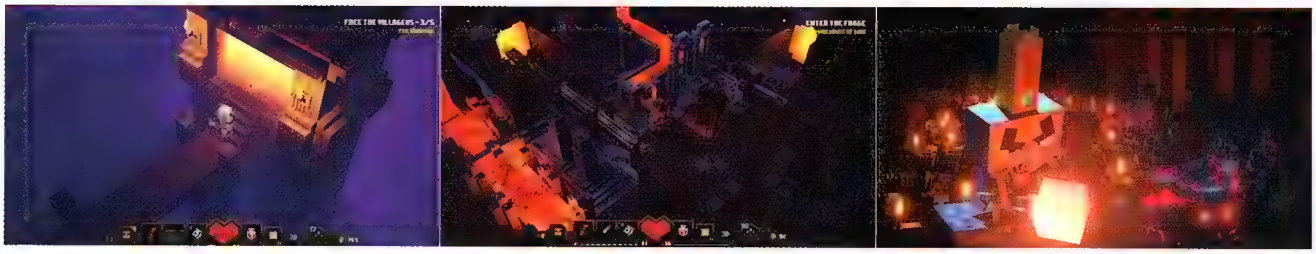
Microsoft's answer to Twitch is an answer no more: as of July 23 the service will be closed. The news comes less than a year after Microsoft paid millions of dollars to popular Twitch streamers in order to secure their exclusivity. Ninja, a popular *Fortnite* streamer, is reported to have been paid up to $30 million dollars to switch to Mixer. These streamers are now free to return to Twitch, or else to Facebook Gaming, which will honour existing partnership agreements, though it appears the streamers themselves will be under no obligation to accept.

"Ultimately, the success of Partners and streamers on Mixer is dependent on our ability to scale the platform for them as quickly and broadly as possible," Microsoft said in a statement. "It became clear that the time needed to grow our own livestreaming community to scale was out of measure with the vision and experiences that Microsoft and Xbox want to deliver for gamers now, so we've decided to close the operations side of Mixer and help the community transition to a new platform."

Kingdoms of Amalur: Re-Reckoning is officially coming in August

THQ NORDIC IS RELEASING A REMASTERED VERSION OF THE 2012 FANTASY RPG *KINGDOMS OF AMALUR: RECKONING* ON AUGUST 18.

The oh-so cleverly-named *Kingdoms of Amalur: Re-Reckoning* is reintroducing the original title with presumably clearer, crisper visuals and improved gameplay. The remaster also includes all DLC previously released for the game. ■



$29.95 | PC, Xbox | xbox.com/en-AU/games/minecraft-dungeons

Minecraft Dungeons

A lightweight dungeon crawler that keeps the sandbox's playful humour.

It's safe to say that *Minecraft Dungeons* doesn't take itself too seriously. It's set in the same universe as its sandbox predecessor, but there's no crafting or building in his world. It's a dungeon crawler that challenges you to furiously hack-and-slash your way through hordes of enemies with an arsenal of fun enchantments and items. I've cleaved a swathe through hordes of slime cubes, shot a mass of burning (and exploding) arrows at spiders, and gone toe to toe with sinister, teleporting Endermen. It's bombastic, frantic fun, and it offers four-player local or online co-op so your friends can get in on its blocky brawls too.

The story is fairly straightforward. The main villain is the evil Arch-Illager, who finds a powerful artefact called the Orb of Dominance and seeks revenge on those who shunned and bullied him. He's gathered an army of familiar *Minecraft* foes to take over the world, and your party must stop him. Occasionally you'll be tasked with freeing captured villagers as a challenge within a level, but the story is mostly just a reason for mindless brawling.

The world of *Minecraft Dungeons* has been given a glorious glow up from its sandbox counterpart. There are a handful of different biomes for you to choose from, including woodland, mine, swamp, temple and canyon areas, each with their own loot drops and enemy types. One of my favourites is Fiery Forge, where glowing red lava cascades into the lower layers of the level. It looks amazing against the blue-infused iron walls of the forge. It's also refreshing to see *Minecraft*'s world from an isometric perspective. In another level, Redstone Mines, you can peer down the mine shafts and watch pulleys lift out the glowing Redstone, giving the level a great sense of depth and character. *Minecraft Dungeons* catapults the blocky world to new heights.

Although each level is procedurally generated, there's always a clear pathway with plenty of nooks and crannies to explore. Each level has it's own mini-dungeon or crypt if you're hunting for extra loot, and some levels even have hidden secrets to new areas or special weapons. You're also given map markers at the edge of the screen to show where your goal is, a bottomless healing potion with a 30-second cooldown, and three lives.

Strategising and theory crafting are great, but charging in headfirst and hacking and slashing through a monster-filled cavern has its own charm. With only a handful of levels, you'll be repeating the same runs a lot, but it's more for finding an item you missed or a hidden secret than tedious grinding. Finishing the campaign, from tutorial to final boss, took me a handful of hours.

Minecraft Dungeons is the perfect introduction to dungeon crawlers for beginners, and a breezy adventure for veterans.

RACHEL WATTS

A chill and simple dungeon crawler that reproduces *Minecraft*'s playful attitude perfectly.

★★★☆☆

$TBA | PC, PS4, XB1, Switch | tripwireinteractive.com

Maneater

Repetitive tasks take a big bite out of the fun.

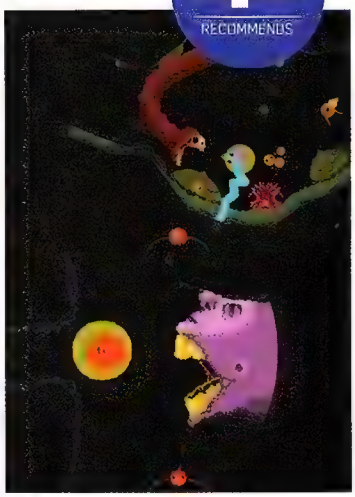
Sharks only do three things, according to Matt Hooper in the 1975 film *Jaws*. They swim and eat and make little sharks. In *Maneater*, Tripwire's action-RPG, you just swim and eat (and sometimes bellyflop onto a golf course), which doesn't sound like enough to propel you through an entire open world RPG. And, unfortunately, it isn't. There's a lot of appeal in growing from a little shark to a hulking leviathan, but there's just not enough variation in the things you do along the way.

Eating ten of something – humans, turtles, fish, seals, other sharks – is initially fun. Humans scream, animals struggle, blood fills the water and coats beaches and boats. Thrashing your shark's head by wiggling the mouse back and forth while holding your prey quickly reduces them to a cloud of chum. But doing it again and again and again (and again), the gruesome novelty wears off quickly and it just becomes a mindless exercise.

There are quests to kill single large predators, too, like a gator, barracuda, or a fellow shark, and more difficult battles against apex predators like an orca in a Sea World-like arena and an ancient sperm whale based on *Moby Dick*. But combat and enemy AI in *Maneater* is pretty sloppy, and I eventually abandoned careful evasion and timed strikes when I discovered that just spamming my attacks worked far better.

The rest of *Maneater* is all collectible-style activities: find every hidden landmark, every sunken crate of drugs (helpful for mutations), every giant spinning licence plate (because in *Jaws*, a shark ate a licence plate, see). These same activities are repeated in every new region you visit, and that's mostly what you do in *Maneater*: swim around looking for collectibles to check off your list while eating 10/10 various creatures when told to. It's just a shame the journey from guppy to megashark monstrosity isn't populated with a wider variety of activities to occupy your time.
CHRIS LIVINGSTON

The fun of being an eternally hungry shark snacking on people wears off quickly.
★★☆☆☆



apc RECOMMENDS

Free | PC, Mac, Linux | bit.ly/SwallowSea

Swallow the Sea

Exploring an ocean of hungry horrors.

You play as a little cell that levels up by swallowing orange, blobby things, before using your newfound power to smash through barriers, and reach new parts of the world. You'll do this a fair few times, gathering even more blobby things, and breaking down bigger barriers, all the while increasing in presence until you resemble a human embryo encased in a bubble.

But the sea isn't kind to people, even when they're weird fish-baby creatures, and most of the things down here are keen to gobble you up – or at least to trap you in place so you're easier prey for their carnivorous mates. So, you have to dodge and dash to give these increasingly horrible sea creatures the slip, while you explore and gather blobs in an aquatic environment.

You will die, quite a bit, in *Swallow the Sea*, but the checkpoints are pretty generous, and you'll want to persist in order to witness its powerful ending. This is a game all about 'the power curve', that sacred cow of game development: you get stronger, and your enemies feel more trivial as the game goes on.
TOM SYKES

It's like *Alien: Isolation*, but with a humanoid snake, and set under the sea.
★★★★☆

Free | PC, Mac, Linux
dmullinsgames.itch.io

Keep it Alive

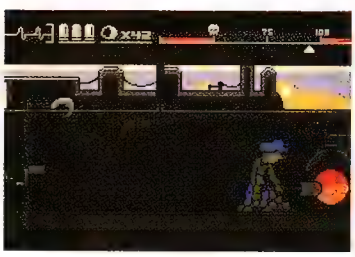
Or die trying.

Here you're running a train all by yourself, by shovelling coal to keep the engine running, aiming a pistol to shoot those hangers-on, and pumping the big freaky heart you're transporting across the wasteland – keeping it alive, as per the title.

This is a one-screen game where you have to keep those multiple plates spinning, on each leg of a journey between the wasteland's surviving stations. If the heart slows down, you'll need to dart back to pump it up, and if the engine slows down, a zombie-style monster will attempt to jump onboard. Your energy might be limitless, but your bullets and coal reserves are unfortunately not, and these will only replenish when you arrive at a train station.

Keep It Alive is a challenging game, but not massively so. Dart back and forth in the carriage too quickly and your shoelaces will untie – ignore this, and you'll trip over, likely at the most inopportune time. The ending might be jarringly silly for most people, but it's the journey that matters here. Quite literally, as a matter of fact.
TOM SYKES

Keeping the trains timely with monsters trying to climb aboard.
★★★½☆



$44.95 | PC | deeprockgalactic.com

Deep Rock Galactic

Hunt bugs and haul mud.

You've no doubt heard that *Deep Rock Galactic* is like *Left 4 Dead*, if Valve's co-op classic swapped zombies for alien arachnids and took place exclusively in dark, confounding tunnels. That's more or less accurate, but *Deep Rock Galactic*'s eponymous depth is more than just environmental. The breadth of approaches possible here makes *Vermintide 2* look like *Desert Bus*, and frankly it's all a bit much for the first few hours.

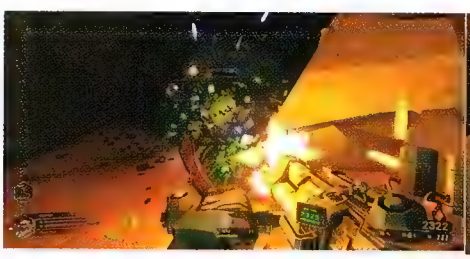
An opening tutorial mission does a fantastic job of conveying the basics, though – this is your pick, use it to hack away at valuable minerals and carve tunnels. Right. Cool. Shoot the gun on the bad spiders – with you there. Call the M.U.L.E. to you and deposit mined resources, press 3 to equip a zipline launcher and 4 to toss a shield. Mine the required materials, dump them in the M.U.L.E., call for evac, then make it out before the dropship leaves without you.

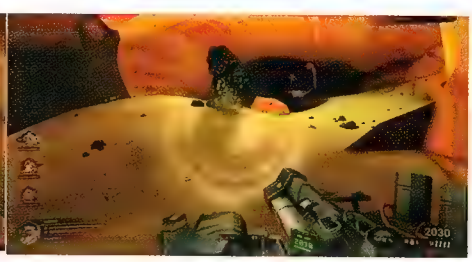
It's a fascinating proposition, and Ghost Ship Games deserves the dedicated fanbase they've found through Early Access by marrying such demanding elements as destructible scenery, class-based co-op, and procedurally generated cave networks.

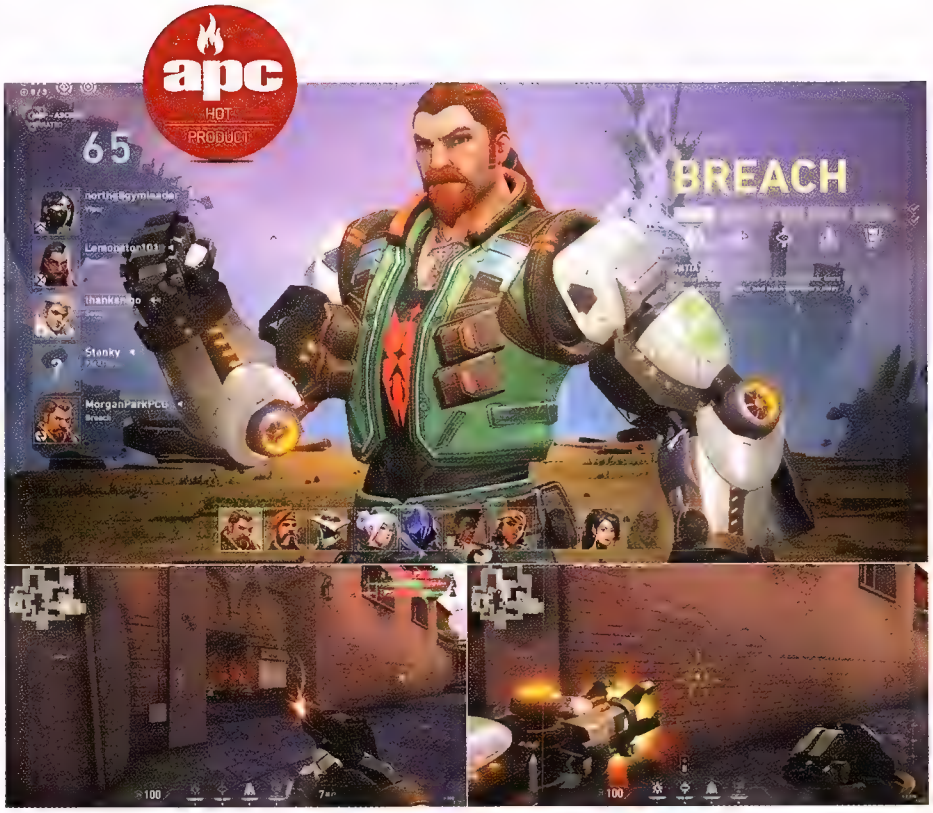
What encourages you to persevere is the sheer ingenuity of other players. The experienced ones, who've been down in these caves since early Early Access, have a knack for turning befuddling topography into fairground rides with three ziplines and some well-placed pick-holes. The division of labour between *Deep Rock Galactic*'s four classes makes the spectacle of player ingenuity all the richer. In the same way you'd just stop and admire a particularly nifty sentry spot or tele placement in the early *TF2* days.

Solo or with fellow humans, *Deep Rock Galactic* is as much a game about learning the hard way and reaping the rewards as it is about dislodging alien terra firma. As such, it's in danger of having many players simply bounce off it, but the hardcore who remain are rewarded with Mariana Trench levels of depth. PHIL IWANIUK

A clear and distinct spin on four-player co-op FPS with atmosphere and ingenuity.
★★★★☆







Free | PC | playvalorant.com

Valorant

Fresh ideas prove that this is way more than a copycat.

It's wild how quickly *Valorant* has captured the collective consciousness of FPS fans. Riot's competitive shooter is just barely out of beta, yet it already stands toe-to-toe with the biggest games in its genre. It helps that *Valorant* comes from a gigantic studio and that its deviously smart partnership with Twitch streamers to selectively hand out beta access gave it a running start. But that enormous marketing push wouldn't mean much if *Valorant* weren't also very good.

Valorant manages to reproduce *Counter-Strike*'s greatest qualities while tossing magical ice walls and drones into the mix. The deliberate detachment from reality allows traditional support tools like smoke, flash, and fire grenades to become playful abilities with varied uses. It's been especially cool to see Sova's tricky recon arrow that players can bank off walls become its own art form.

I love the ways Riot has found to add value to the team beyond clicking on heads, but a few powers don't gel with its lethal combat. Striking a balance between *Overwatch* – where accuracy feels secondary to a well-timed ult – and *Counter-Strike*'s purist weapon jousting is a difficult feat.

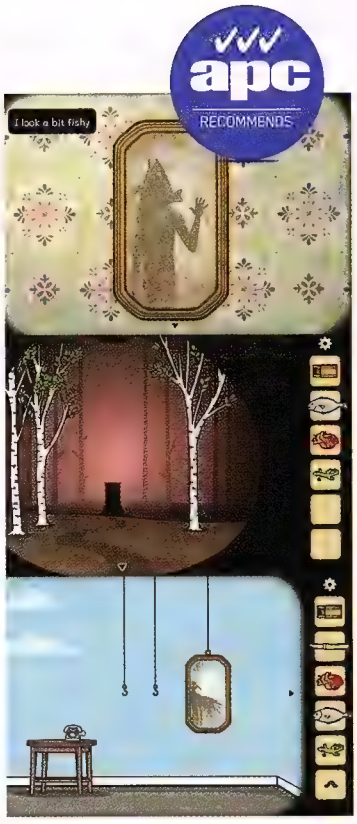
The only area where *Valorant* feels a bit shallow at launch is its map pool. There are four maps so far. It's slim pickings, but I appreciate the variety in layout and style. Riot says it wants each map to feature something "new and unique" – Bind has portals that connect the two sites, Haven's mid is a third bomb site, Split has climbing ropes, and Ascent (the new map) has one-way metal doors. For the most part, *Valorant*'s map design succeeds at replicating *Counter-Strike*'s carefully considered sightlines and chokepoints. It'll take months for the community to fully evaluate each map's strengths and weaknesses, but I'm having fun wherever I end up. I'd wager that Riot is afraid of overwhelming new players with too many maps.

Valorant is the more accessible *Counter-Strike* I didn't know I wanted. Abilities add an intoxicating dynamism to every round and expand the scope of teamwork for this style of FPS.

MORGAN PARK

With intense gunplay and transformative agent abilities, *Valorant* is an exceptional FPS that everyone should try.

★★★★½



Free | PC | bit.ly/3dEhTPz

Samsara Room

Life after death.

Developer Rusty Lake has already made 15 games in its five years of operation. The team's latest room-escape-ish adventure game is actually a remake of an older title, updated with new art, music, more puzzles.

Themes of life, and death, and rebirth, and having a fish for a head lie at the heart of this puzzle game, whose best feature is its surreal, *Twin Peaks*-y atmosphere. It may take place inside one room, but you'll test that premise to its limit by turning the contents upside down, by filling it with water, and by getting a worm's-eye view of your environment. It's room escape taken to a fantastical extreme: a spiritual journey, as you escape the realm of the dead.

Puzzles are everywhere, satisfyingly tactile, hard but not too hard. Just when you think, "Oh, I've finally found a shit one," you locate a pattern that unlocks the solution – *Samsara* transcends the frustrating trial-and-error often packaged with pure puzzle games like this.

TOM SYKES

Samsara Room is a must-play if you enjoy poking at tactile puzzles.

★★★★☆

Shifter's
Quick-Sta

The objective being played.

DEVELOPER VALVE **PUBLISHER** IN-HOUSE **RELEASED** OCTOBER 10, 2007 **WEB** teamfortress.com

Team Fortress 2

Phil Savage explores a game that is simultaneously old and new, experimental and nostalgic.

The received wisdom is that *Team Fortress 2* has changed, and not for the better. The argument, often made by former players, is that everything Valve has added to the game over the last 13 years – the hats, the achievements, the jars of human piss – has diluted the spirit of what *TF2* once was. I've fallen into the same trap myself over the years, bemoaning that the game I once loved no longer exists.

It would be absurd to suggest that *Team Fortress 2* hasn't changed; it was arguably the poster child for games-as-a-service design. It's evident in everything from the menus to the way you start a match. Nevertheless, returning after years away, I'm struck by how much of the core appeal remains. There is more now: more maps, more weapons, more customisation options, more effects. Sometimes there are lasers. Sometimes you'll be drenched in milk. In a handful of ways, though, this is still the *TF2* that became one of the most influential online shooters of the 21st century so far.

Load into a match and you'll still get teammates in your home spawn accusing every player of being a Spy. You'll still get intractable 2Fort stalemates, as players abandon the objective in favour of an endless deathmatch. You'll still get sniper wars and W+M1 Pyros. Most importantly, you'll still get the clarity of purpose and personality of its nine classes, who retain their role and at-a-glance design, even as their arsenals and accoutrements have grown over so many updates.

Class act

The classes are the heart of what made *TF2* such an enduring phenomenon, and in retrospect laid the path for the character-led template of the subsequent hero shooter craze. If a medic in *Battlefield 2* was more uniform than man, the Medic in *Team Fortress 2* was an actual person. We 'met' him, and the other mercenaries, through a series of vignettes released over a period of years – each one increasingly elaborate until *Team Fortress 2* was a full universe of relationships and conflict; antagonistic administrators and boisterous, technologically advanced Australians.

Overwatch and its ilk would go further, drawing on *League of Legends* and *Dota 2* to make actual characters with names and abilities to go along with their distinct weapon sets. But *Team Fortress 2*'s proto-style has merit. To modern eyes, this undefined melding of class and character feels more awkward, yes, but also more playful. It lampshades the inherent absurdity of the same characters fighting an endless conflict – largely defined by being

Why can't laser guns be sniper rifles?

Soldier pays tribute to his voice actor, the late Rick May.

In *TF2*, fashion is just a state of mind.

dressed in either red or blue clothes – and thus invites you to revel in it too. It's impossible to take the conceit seriously, creating a charmingly slapstick battlespace, despite all the blood and gibs.

It's refreshing – after years of seeing characters like *Overwatch*'s Reaper and *Apex Legends*' Revenant – to be playing a game that so fully rejects being dark or edgy. But more than a tonal triumph, I'm taken by how unexpectedly restrained *Team Fortress 2*'s class design feels. Where once nine distinct playstyles felt like a lot, now it's at the low end of a videogame roster list. And while each has been broadened over the years, even the wildest of weapon loadouts won't change the basic role each class was made to fill. The Pyro still burns things. The Sniper still does long range, precision damage. The Scout, well, they're still a prick.

Arguably Valve's boldest design decision – one that's remained steadfast throughout *TF2*'s lifespan – was not to include an assault rifle. It's too blandly effective for a game built around player limitation. The Heavy's minigun might be able to cut down swathes of enemies, but it comes with inherent compromise: slow movement, a long spin-up time, a large, dominating hitbox. Each class comes with a similar in-built weakness, usually in the form of another class that acts as a hard counter, in a way that creates more of an unspoken sense of team cohesion than in other games of its type.

Dream team

A problem that *Overwatch* has never elegantly solved is incentivising players to switch heroes based on the team they're facing. For starters, the loss of your ultimate ability's charge means there's a cost for making a change. More deeply, though, it's harder to master a large roster's range of quirks and abilities and counters, meaning players trend towards picking a single 'main', or

NEVER GO HOME AGAIN

Six key updates in *TF2*'s history

APRIL 29, 2008
GOLD RUSH UPDATE
The first major update added the payload mode and began the process of giving each merc an alternate weapon set.

OCTOBER 29, 2009
HAUNTED HALLOWEEN SPECIAL
The first Halloween event added koth_harvest and also filled out the lore of the ridiculous Mann family.

AUGUST 15, 2012
MANN VS MACHINE
This added a co-op horde mode against robotic versions of the mercs.

MAY 21, 2009
SNIPER VS. SPY UPDATE
This added the hats. And also the piss.

SEPTEMBER 30, 2010
MANN-CONOMY UPDATE
TF2 gets item trading and loot boxes. At its height, stories about the wild *TF2* earbud market were more fascinating than the game itself.

JULY 7, 2016
MEET YOUR MATCH UPDATE
Arguably the last of the real game-changing patches (so far?), this added matchmaking for casual and competitive play.

A face of pure indifference.

at least a handful of characters that they feel most comfortable with.

Team Fortress 2 doesn't have this, at least to the same extent. I use Scout more than any other class, but have no qualms about switching if I'm staring down the barrel of a sentry nest. It feels like an essential part of play. You encounter problems that your team composition can't handle, and make changes as needed.

That's the ideal, at least. Sometimes, you are going to be matchmade onto a team with six Spies. Some people are just beyond help, no matter what game you play.

This is where *Team Fortress 2*'s template can break down. Its round times are longer than most hero-shooters, which, if both teams are rebalancing around each other, can make for thrilling last-minute plays that change the course of the match. But if that cohesion doesn't exist, then you're likely in for a bad time.

You can experience this for yourself. Just queue up for a round of 2Fort and it will happen sooner rather than later. And when it does... it's fine. Yes, *Team Fortress 2* has matchmaking now, but its heart is still the server browser – a rare and beautiful thing for a game with a still-active playerbase. Matchmaking is a performance, where you queue up and get one shot to impress the people that you're grouped with. More than that, the individual tracking and reward structures that were built to incentivise repeat play – K/D ratios, XP and levels – give a heightened meaning to both individual and team performance. While there are benefits to this, it can be exhausting. You're encouraged to always be 'on'; to perform at your best and never mess up.

Hats off

Team Fortress 2 also has levels and XP now, but how players perceive a game's purpose is a harder thing to shift. The existence of the server browser invites players to take individual matches less seriously, because servers are a hangout rather than an individually portioned measure of skill. Each server has its own personality – it's a place you visit for a specific type of game, even if that game is loaded with so many custom rules, maps, and modes that it barely resembles *TF2* anymore.

Valve used *TF2* as a testing board for what games-as-a-service should be – the hats, the crates, the marketplace, the crafting. Outside of play, the game can at times feel like a 13-year-long brainstorming session, filled with different ideas – some written over each other, others hastily wiped off leaving just the faintest trace of what remained. This is what makes *TF2* such a fascinating game to reinstall. It's simultaneously old and new and experimental and nostalgic. Its magic is weirdly ephemeral, existing as a morass of elements from throughout its history.

This is why anyone arguing that it should have been preserved in amber is missing the point. Even if you could load up the version of the game that existed in 2008, you couldn't recreate the specific servers and memes and the ecosystem of PC gaming and multiplayer shooters of the time. *Team Fortress 2* has changed. But so have you. ■

NEW IN APC

MACHINE OF THE MONTH

BBC Micro (1981)

You may never have heard of the BBC Micro, but in 1980s Britain, this beige box would find its way into almost every school in the nation, as John Knight explains.

For many Brits, the BBC Micro would be their first experience using a computer, inspiring new coders across the country. With a production run reaching into the mid-90s, it was a national institution. Indeed, it was the BBC Micro that inspired both the Raspberry Pi and its Model A and B naming scheme.

Although the BBC Micro was too expensive to be a popular home games machine, those who indulged it were rewarded with a beautiful version of BASIC and lots of great games, such as *Chuckie Egg*, *Exile*, *Citadel*, and *3D Dotty*. Nevertheless, BBC Micros are hard to find in Australia, leaving emulation as Australians' only real option. So, join us as we take you through a history of the BBC Micro, and provide instructions for getting you gaming in the fastest, most painless way.

Battle for the BBC

The BBC Micro was born out of fierce competition between British computer makers. Worried that Britain would be left behind in computing, the government designed a national computer literacy project. Planning a BBC television series – *The Computer Programme* – this would be tied to a specific computer, which would be bought for schools.

Winning such a contract would be enormously lucrative, with every maker putting in their bids. Ultimately, it boiled down to two competitors: Sinclair Research and Acorn Computers. Sinclair Research was led by famous British inventor, Clive Sinclair. Acorn Computers was led by ex-Sinclair employee, Chris Curry. Curry had left Sinclair on unfriendly terms, and for several years, the two firms had a bitter rivalry.

When the BBC came calling, Sinclair's proposed model had a cheap rubber membrane keyboard, which simply didn't suffice, leaving Acorn the only convincing bid. However, the proposed model didn't actually exist, and Acorn only had a week to build it.

Most of the Acorn team was convinced the task was impossible, but by stripping down an existing Acorn prototype (the "Proton") and working through the night for the next week, they just about managed to cobble together a working prototype by the last minute. The BBC was suitably impressed, and Acorn won the contract.

YOU'LL NEED

WINDOWS OR LINUX PC
These emulators run on any modern PC, but Linux users need a stable version of Wine.

JOYSTICK
A USB joystick makes life easier in some games.

You're unlikely to have used a BBC Micro unless you lived in the UK.

Built with schools in mind, these machines have an extremely rugged case, with only a keyboard in view for kids to bash around. Switch on the machine and you're immediately greeted with a BASIC prompt, ready to code from the get-go. Look behind the machine and there is an enormous number of connectors and expansion options, with modifications being common among serious users.

On launch, there were two models: the Model A with 16K of RAM, and Model B with 32K. The Model B is more common. Although generally too expensive for families, the Micro found its way into the majority of British schools.

Gaming

Despite being on national television and installed in most schools, the Micro was uncommon in homes, losing out to Sinclair's ZX Spectrum and its enormous game library. However, 1984's *Elite* earned the Micro its place in gaming history. An astonishing achievement for the time, people could now explore an entire galaxy in wireframe 3D – all in something smaller than most JPEGs. An imperious game for an imperious machine.

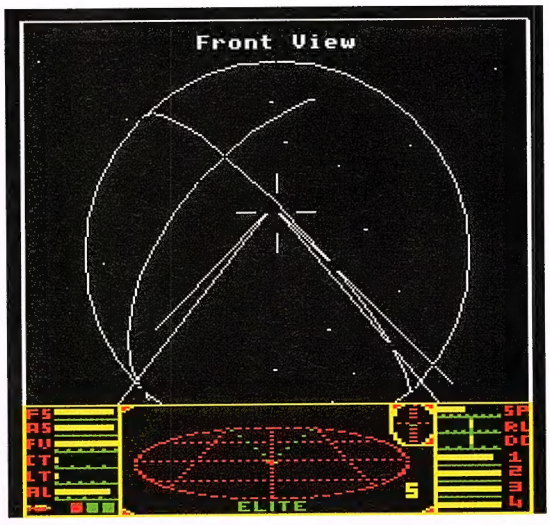
Coming from an early era of home gaming, most Micro games have a feel somewhere between an original Atari and a Commodore 64 (despite the BBC having a faster CPU than either). Later games became more advanced, such as *Impossible Mission*, *The Sentinel*, or *Stunt Car Racer*. Graphics are generally better than a Spectrum, but not as good as a Commodore.

>> Recognising the potential of the gaming market, and wanting to appeal to home users, Acorn released a cut-down version of the BBC Micro: 1983's Acorn Electron, which was a

Find software

The list of commercial BBC Micro games isn't enormous, but that doesn't mean there aren't plenty of games. The Micro's real scene was in DIY coding, as was the BBC's intention, so the real gold is in program listings. **Archive.org** has magazines such as *BBC Micro User* and *The Micro User*, with listings to be typed out verbatim, enabling you to try out games and learn BASIC as you go.

As for commercial releases, fan archives exist aplenty, and are easily searched, but we can't advocate these for legal reasons. **BBCMicro.co.uk** is the most thorough and convenient (everything is on a simple disk image), but we doubt it has legal rights to do so. Something we can recommend, however, are the websites **www.rucksackgames.co.uk** and **www.retrosoftware.co.uk**, where you can get newly released software for the Micro, both commercial and freeware. Modern gaming highlights include *White Light* (2017), *Repton: The Lost Realms* (2010), and *Mountain Panic* (2013).



moderate success. Most commercial releases are written with both machines in mind.

How to emulate it

For the best emulators, our two choices are BeebEm and Horizon. BeebEm is the easiest to use, and runs UEF tape files, but may not run everything. Horizon is a bit trickier to use, but has features such as automatic key remapping. Overall, we recommend installing both. Each program covers the other's gaps nicely, and between the two, most titles should work.

Note: The BBC Micro doesn't have arrow keys. Games often standardise on either A, Z, <, and >, or :, /, Z, and X. That : key causes problems, meaning you'll need to remap your keys at some point.

Lastly, try to source disk images when possible. Tape files require several BASIC commands, and can take a long time to load. If you are using a tape image, load the file, and most software should work by entering these commands:

```
*TAPE
PAGE=&E00
CHAIN ""
```

BeebEm

Windows users: Head to the website (**http://www.mkw.me.uk/beebem**), where there is a self-extracting EXE installer, which will create menu entries and desktop icons.

Linux users: Although a Linux port exists, it's very old, difficult to get running, and doesn't have all the features of the Windows original. However, the Windows version runs decently under Wine, so just use that.

BeebEm comes with a number of utilities and even a game disk, offering *Chuckie Egg*, *Dare Devil Dennis*, *Zalaga*, and *Cylon Attack*. Loading disks is easy. Simply open the main menu, choose "File > Run Disc," then select your disk image. BeebEm automates the loading, entering BASIC commands for you.

Tapes are somewhat more difficult. From the main menu, you need to choose "File > Load Tape," and then open your tape image. At this point, however, nothing will happen – you need to enter the BASIC commands we gave above, and you should expect long loading times.

While BeebEm enables you to define your own keys ("Options > Define User Key Mapping"), you'll probably mess up one key by redefining another. If any keys aren't working, Horizon might be a better choice for that program.

Horizon

Although there are only Windows and Mac versions of Horizon, worry not, Linux users. Where BeebEm runs decently under Wine, Horizon runs almost perfectly. Horizon doesn't come with an installer utility, so you'll need to download the zip file, then open the EXE file manually – you might want to make a desktop shortcut.

If you open the "Input" menu, there are predefined key remapping options. Unfortunately, loading programs is unintuitive in Horizon, and UEF tape images don't work (use BeebEm instead for those).

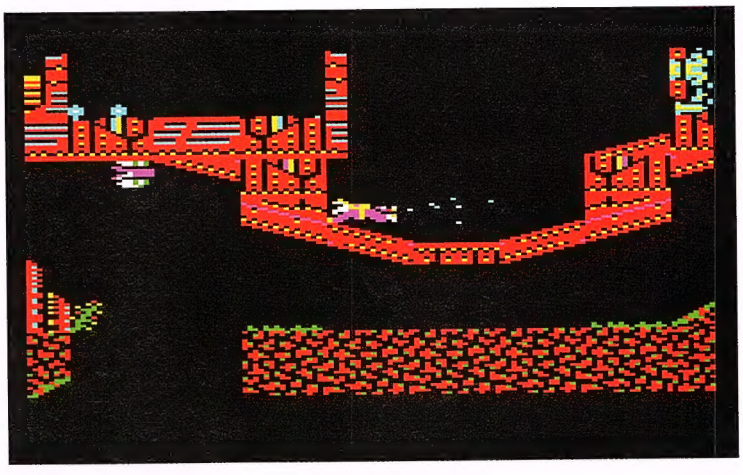
To load a disk image, open the main menu and choose "Drive: 0 > Auto Boot." Now run your disk by choosing "Drive: 0 > Insert Disk Image."

To load a tape image, first give it its own folder, and put the file there. Now load it by clicking "Tape: > Select Folder," then entering the BASIC commands given previously. ■

Mention BBC gaming, and the first title people think of is usually 1984's *Elite*.

SPECIFICATIONS

CPU MOS Technology 6502 @ 2MHz
RAM 16/32KB
Launch price £235 Model A, £335 Model B
Graphics 640x256, 8 colors
Sound Instruments SN76489, four mono channels
Storage Cassette and 5.25-inch floppy
OS BBC BASIC
Released December 1981
Production 1981–1994
Worldwide sales 1.5 million



BBC games have a striking chunky aesthetic – expect a lot of red, yellow, green, and blue on black backgrounds.

CHIP CHAT

JOEL BURGESS REPORTS ON THE UNUSUAL SIDE OF TECH NEWS

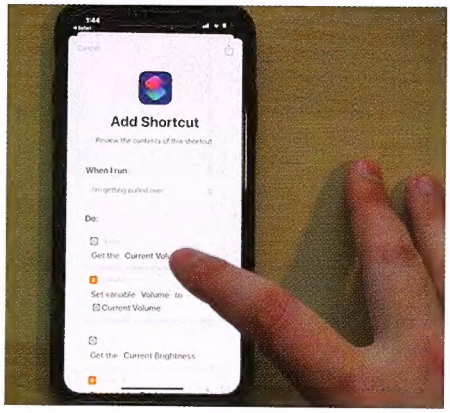
Visit a *Minecraft* photo exhibition during lockdown

Aussie photographers document 2020 bushfires in the online virtual gallery.

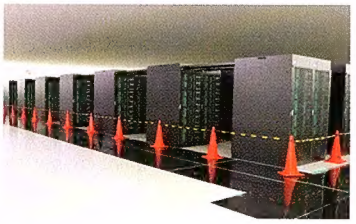
A photographer from the south coast of NSW held a photographic exhibition to raise money for bushfire relief entirely in a built *Minecraft* arena. The exhibit, titled Still Burning, was intended as an online fundraiser to help those affected by the 2019/2020 bushfires and can be accessed at 'still_burning.apexmc.co'. While the *Minecraft* gallery setting was initially intended as a joke, it was also one of the only ways to hold such an event during the COVID-19 lockdown conditions. It might seem straightforward enough to host a *Minecraft* exhibition, but the game doesn't actually allow you to insert image files into it, so the host, Jason De Freitas, had to convert each photograph into 64 *Minecraft* maps in order to display them collectively as 1024 x 1024 pixel minimaps in the game.

Siri quick record shortcut makes it easy to capture official misconduct

'Hey Siri, I'm getting pulled over' helps iPhone users contribute to better policing.



An iPhone user in the US has created and shared a shortcut for Apple smartphone users to allow them to quickly start recording audio and video when they are confronted by members of the police force. The shortcut requires a third party application called Shortcuts to be installed, but then you are able to use the command "Siri, I'm getting pulled over" to have the assistant start recording a video without having to touch the smartphone. The shortcut will hopefully expand the coverage of police interactions and capture any problematic incidences to better facilitate the oversight of these officials.

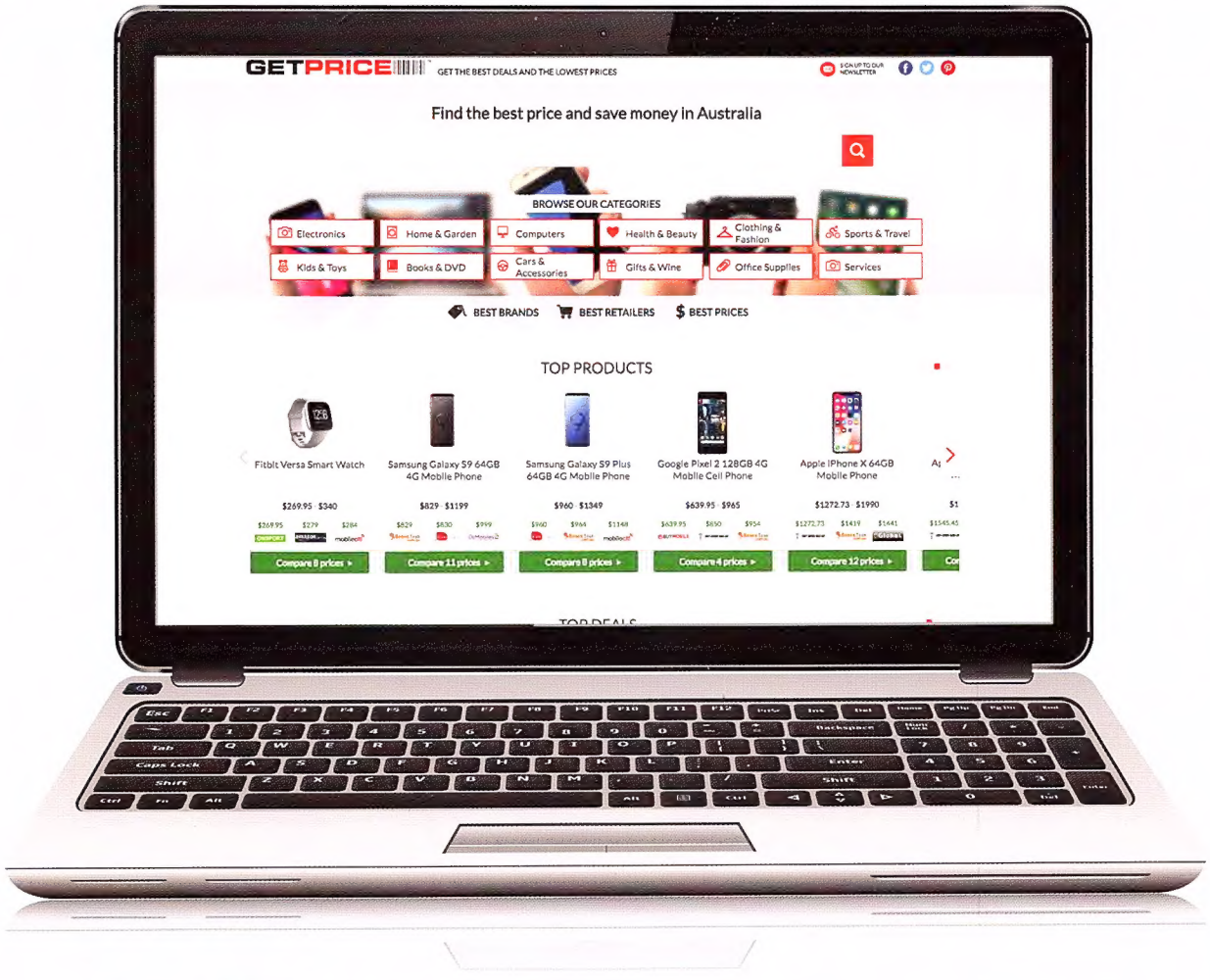


ARM now has a supercomputer 2.8 times faster than anything else

Just as Apple announced it'd be swapping to ARM-based processors for upcoming Mac computers, the world got a new ARM-based supercomputer that is 2.8 times more powerful than the next biggest rig. The new Fujitsu A64FX based Fugaku supercomputer is believed to have cost the RIKEN Centre for Computational Science in excess of US$1Bn and took over six years to design and build. The title for the world's most powerful computer never lasts long, and Cray Computing is already partnered with AMD to build a 30% more powerful 1.5 exaflop system for the Department of Energy and Oak Ridge National Laboratory.

Hurricane predictions difficult without plane and cruise ship data

While you've probably heard about the positive environmental effects that emerge as an unintended consequence of the COVID-19 travel bans, you may not have expected it to have impeded our ability to predict the weather too. The advanced meteorological sensors onboard commercial cruise liners and passenger jets collect a lot of information about the climate in the more obscure regions of the globe and weather experts are now highlighting that transport feedback is the second most important data behind satellites, for extreme weather predictions. Cinchar, the meteorologist for *CNN*, is stating that the cone of uncertainty for hurricane predictions is likely to be much bigger this year.



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